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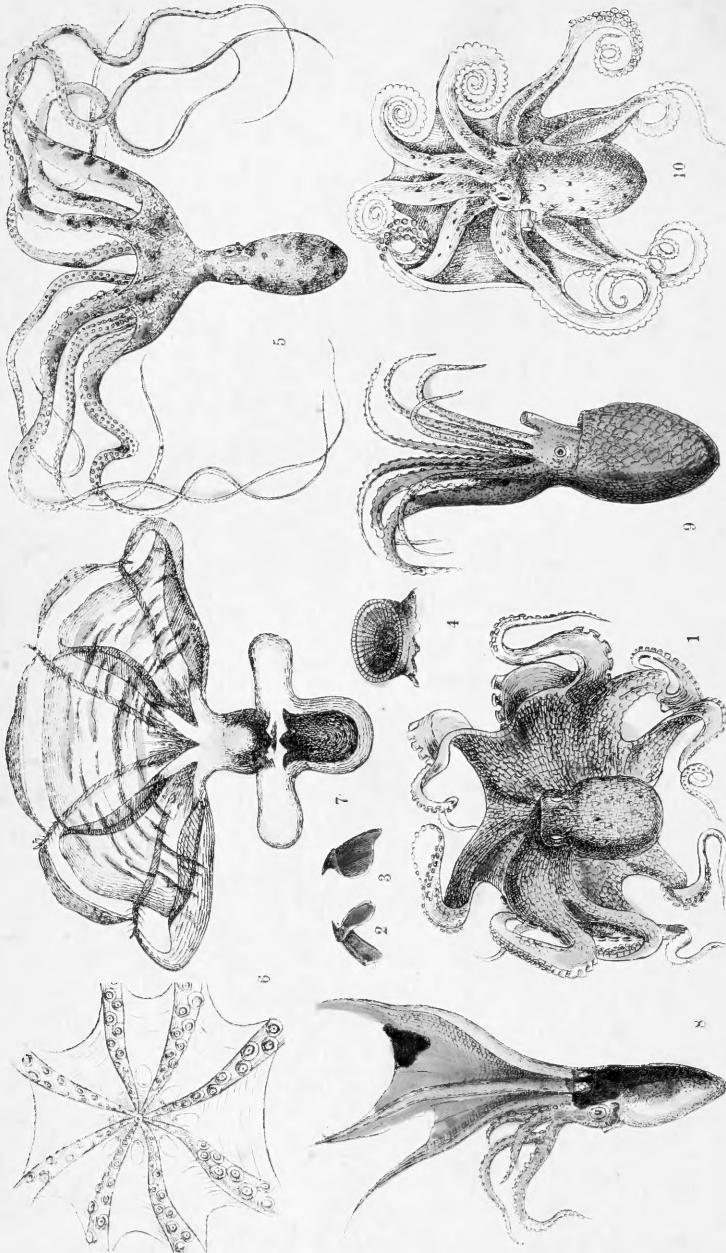
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CONCHOLOGY:

AN INTRODUCTION TO THE STUDY OF THE

MOLLUSCA.

VOL. II.

BY GEORGE W. TRYON, JR.

CONSERVATOR OF THE CONCHOLOGICAL SECTION OF THE ACADEMY OF NATURAL
SCIENCES OF PHILADELPHIA.

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SYSTEMATIC CONCHOLOGY.

CLASS CEPHALOPODA.

Head large, connected with the body by a neck, and furnished with complex, sessile or pedunculated eyes; mouth with a pair of mandibles or beaks, resembling those of a parrot, edged with fleshy lips, and surrounded by a circle of arms.

As pointed out in the structural portion of this work, the Cephalopoda are related to the vertebrata in several particulars: in the mode of segmentation of the vitellus, in their internal cartilaginous support—a simplified skeleton; in their circulation furnished with true capillaries, their blood corpuscles, their more highly developed eyes, mandibles, etc.

Differing from other mollusks by their symmetry as well as in the above details, they nevertheless present, with more or less modification, the main distinctive features common to other classes of the subkingdom Mollusca.

The Cephalopoda are essentially carnivorous; their nourishment is derived from fish, the migrations of which they follow, and from pteropod mollusca. Certain sedentary species eat crustaceans, nudibranchiate and bivalve mollusks and bryozoa. After their exclusion, the young prey upon polyps, notably on those of the family Gorgonidæ, so common on the Algerine coast, and some of which, perhaps, furnish the material necessary for the growth or solidification of the cuttle-bone. A little larger, they attack with avidity those elegant chaplets of pearls, the rainbow-hued eggs of *Eolis* and *Doris*.

The number of cephalopods of small size is exceedingly great, but they become the prey of a multitude of enemies. On the 10th Jan., 1858, the Dutch ship *Vriendentrouw* sailed for two hours through dead *Loligos*, covering the surface of the sea as far as the eye of the lookout could reach. Mr. Vrolik found in the stomach of a *Hyperoodon* about ten thousand mandibles of *Loligo*.

It is the opinion of almost all whalers, that the sperm whale feeds wholly on squid. Capt. Daniel McKenzie, of New Bedford, says: "The smaller kind they eat is found near the surface, and is from 2 to 3 feet in length; the larger kind, which probably have their haunts deep in the sea, must be of immense size. I have seen very large junks floating on the surface entirely shapeless." Capt. Francis Post says: "Whales in the agony of death, frequently eject from their stomach pieces as large as the bulk of a barrel, and these in large quantities. Large pieces of squid are often seen floating on the sea, which whalers consider indicate good whale-ground."—*Am. Naturalist*, vii, 90, 1873.

Cuttle-fish are used so extensively for bait at Newfoundland, that half of all the cod taken is fished with them. The cuttle occurs "in vast abundance, but at different times on different coasts; for example, at St. Pierre in July, on the southern coasts of Newfoundland only in August, and in Bouna Bay first in September. Its vast shoals present a curious appearance, by their strongly twisted, compact form. When they approach, hundreds of vessels are ready for their capture. At this season of the year, the sea on the coast of St. Pierre is covered with from 400 to 500 sail of English and French ships, engaged in the cuttle-fish fishery. During violent gales of wind, hundreds of tons of them are often thrown up together in beds on the flat beaches, the decay of which spreads an intolerable effluvium around. It is made no use of, except for bait; and as it maintains itself in deeper water than the capelan, instead of nets being used to take it, it is jigged—a jigger being a number of hooks radiating from a fixed centre, made for the purpose. The cod is in best condition after having fed on it. Another method of taking them is sometimes resorted to. Fires are made all along the shore during the night, when the *Loligo*, attracted by the light, approaches too near for his safety, and is left on the strand by the recess of the tide, when the fishermen go to gather them."—*Edinb. New Phil. Journ.*, viii, 395.

In the Polynesian Islands, the natives have a curious contrivance for catching cuttle-fish. It consists of a straight piece of hard wood a foot long, round and polished, and not half an inch in diameter. Near one end of it, a number of beautiful pieces of the cowrie, or tiger shell, are fastened one over another, like the scales of a fish, until it is nearly the size of a turkey's egg, and resembles the cowrie. It is suspended in a horizontal position by a strong line, and lowered by the fisherman from a small canoe till it nearly reaches the bottom. The fisherman jerks the line to cause the shell to move, as if it were alive, and the jerking motion is called "tootoofe," the name of the contrivance. The cuttle-fish, attracted by the cowries, darts out one of its arms, and then another, and so on, until it is quite fastened among the

openings between the pieces of the cowrie, when it is drawn up into the canoe and secured.—*Lowell's Edible Mollusks*, 167.

Most of the species of octopods and the Nautilus are littoral in habit, and have thence been conjectured to enjoy but a limited distribution; and this is held to justify the multiplication of specific names. This reasoning is, however, fallacious, as it is well known that many littoral mollusks, not nearly so well provided as these with the means of swimming, have become world-wide in distribution. So many particular species of Octopus are known to inhabit the shores of distant countries, that a large proportion of the species which have been distinguished by slight and mutable characters, and by their geographical distribution, will probably need to be united when sufficiently studied. This probable extensive distribution of living littoral species corresponds with observations made upon fossil species of Ammonites, Nautilus and other chambered genera, which are proved to have been littoral in habit by their occurrence only in deposits representing ancient sea-shores. Not to multiply examples amongst these fossils, it may be mentioned that *Nautilus simplex* occurs in Europe, East Indies and Texas; that *Ammonites Rotomagensis* is found in Europe, East Indies, N. and S. Africa and S. America; and that *Baculites anceps* had even a wider distribution. Nevertheless, temperature has been observed to have some effect upon the distribution of the living Octopoda of Europe, similar but distinguishable forms or species inhabiting its northern seas, from those of the Mediterranean. As in Molluscan life generally, the development of specific forms has been greatest in tropical waters.

It is altogether probable that the pelagic cephalopods, highly organized, with powerful locomotive apparatus, and frequently attaining great size and strength, may enjoy a distribution fully equal to that of the littoral species: such is known to be the case in some species which, normally circumboreal in distribution, are found nevertheless extending into temperate latitudes in both oceans.

Order 1. DIBRANCHIATA.—Breathing by a single pair of internal symmetrical branchiæ or gills. Eyes sessile. Mandibles horny. Arms, eight or ten, furnished with rows of acetabulæ or suckers. Body sometimes laterally or posteriorly finned. Shell internal, or none.

Order 2. TETRABRANCHIATA.—Breathing by two pairs of symmetrical branchiæ. Eyes pedunculated. Mandibles shelly. Arms very numerous, without suckers. Shell external, chambered; capable of containing the animal.

ORDER I. DIBRANCHIATA.

Suborder 1. OCTOPODA.—Arms eight, sessile; no shell.

(The so-called shell of the argonaut, is the egg-nest of the female.)

Suborder 2. DECAPODA.—Ten arms, of which eight are sessile, and two (longer) tentacular. Shell internal.

SUBORDER I. OCTOPODA.

(*Littoral.*)

Family OCTOPODIDÆ. Mantle supported by fleshy bands. No cephalic aquiferous pores. Arms subulate, elongated, more or less united by webs; their suckers sessile.

(*Pelagic.*)

Family TREMOCTOPIDÆ (PHILONEXIDÆ). Front of mantle supported by two cartilaginous buttons at the base of the siphuncle, fitting into grooves on the inner side of the mantle. Aquiferous pores on the back of the head. Suckers pedunculated.

Family ARGONAUTIDÆ. Mantle supported by two buttons fitting into grooves at the base of the siphuncle. The two upper or dorsal arms (in the female only) expanding into velamenta or broad webs at their extremity, from which an egg-nest (shell) is secreted. Cups slightly pedicelled. A pair of aquiferous pores at the upper hinder angle of the eye.

SUBORDER II. DECAPODA.

A. Decapoda chondrophora. Internal shell horny.

a. Myopsidæ. Eyes covered by skin: mostly littoral species.

Family LOLIGINIDÆ. Body rather long; buccal skin sometimes armed with suckers; tentacular arms only partially retractile; fins lateral-terminal. Inner shell or gladius as long as the back.

Family SEPIOLIDÆ. Body short; buccal skin without suckers; tentacular arms completely retractile; fins short, in the middle of the sides of the back. Gladius only about half as long as the body. First pair of dorsal arms hectocotylized in the male; spermatophores attached around the orifice of the oviduct.

b. Oigopsidæ. Eyes naked: pelagic species.

Family CRANCHIIDÆ. Body rounded; mantle united to the head by a cervical band, and upon either side connate with the base of the siphon; head small, with large eyes; arms short; tentacles long; siphon long, not fastened to the head, and with or without inner valve. Shell or gladius as long as the body, small, lance-like.

Family CHIROTEUTHIDÆ. Body rather long; mantle supported on the body by cartilaginous ridges; sessile arms, long, partially

webbed; tentacles very long, not retractile; siphon short, without attachment to the head, or valve. Shell or gladius small, long, lance-like.

Family THYSANOTEUTHIDÆ. Body rather long or oval; mantle supported by cartilaginous ridges and grooves; arms free; siphon united to the head by two bands. Gladius dart-like.

Family ONYCHOTEUTHIDÆ. Body long, cylindrical; mantle supported by cartilaginous projections; eyes with a lachrymal sinus; arms or tentacles armed with hooks; siphon with or without bands and valve. Gladius generally lancet-form, with an end-conus.

Family OMMATOSTREPHIDÆ. Body long, cylindrical; arms short, armed with suckers only; the short tentacular arms non-retractile; siphon valved, united by bands to the head. Shell small, lancet-form, with an end-conus.

B. Decapoda calciphora. Internal shell calcareous.

a. Sepiophora. Shell blade-like.

Family SEPIDÆ. Eyes covered by skin; littoral. Body oval, with long lateral fins, uniting behind; mantle supported by cartilaginous tubercles fitting into sockets on the neck and siphon; arms with suckers, tentacular arms entirely retractile; siphon valved. Shell (cuttle-bone, sepion or sepiostaire) broad, flat, thickened internally by numerous plates, terminating behind in a hollow, imperfectly chambered apex or muero, without connecting siphon.

b. Phragmophora. Shell forming a series of chambers traversed by a siphon.

Family BELOSEPIDÆ. (Fossil only.) Shell like Sepia, but the walls of the chambers of the muero pierced by small holes, indicating the existence of a connecting siphon. Animal unknown.

Family BELEMNITIDÆ. (Fossil only.) Animal, arms with hooks. Shell a pen (pro-ostracum) attached to a chambered cone (phragmocone), the partitions of which are pierced by a sub-marginal, ventrally-placed siphuncle; at the hinder end the phragmocone is enveloped by a rostrum.

Family SPIRULIDÆ. Animal, body oblong, with minute terminal fins; mantle supported by a cervical and two ventral ridges and grooves; arms with six rows of minute cups; tentacular arms elongated; siphon valved. Shell spiral, whorls on the same plane, not in connection, chambered; chambers connected by a ventral siphon, invested by a series of cone-shaped tubes, one for each chamber. The shell is placed vertically in the end of the body, and is held in place by side flaps of the mantle.

The above succession of families indicates a progression from the so-called naked octopods (with the internal shell represented

by cartilaginous styles), through the cartilaginous-shelled Cirroteuthis, to the decapods with horny pens:—then those with calcareous plates and minute initial chambers, the latter of which gradually become larger, are siphunculated, curve, become spiral and thus form a passage into the fossil tetrabranchiates and the externally-shelled Nautilus. It is not impossible that in some of the ancient genera, the structure of the animals was such as to bridge over the gulf which now exists between the two orders: this has been recently maintained by M. Munier-Chalmas, and more cautiously by Dr. Paul Fischer.

SUBORDER I. OCTOPODA.

Animal bursiform, body rounded or ovoid; eyes fixed; shell usually absent, sometimes represented by internal cartilaginous stylets, or externally by a calcareous nest for the eggs, formed by the female only; siphon without valve; eight arms with fleshy suckers (without corneous rings) on their inner face. Males modifying one of their arms for copulation, and frequently detaching it during the act.

FAMILY OCTOPODIDÆ.

Synopsis of Genera.

a. Arms with two rows of suckers.

** Body not finned.*

OCTOPUS. Body rounded. Arms long. Suckers sessile. Third right arm of male hectocotylized.

CISTOPUS. Differs from Octopus in having a small aquiferous system, consisting of a bag with a small pore at its lower edge, upon the web between each arm.

SCÆURGUS. Body oval, wider than the head; arms short; cups with narrowed bases. Third left arm hectocotylized.

ALLOPOSUS. Arms united by a web nearly to the ends.

** * Body finned.*

PINNOCTOPUS.

b. Arms with a single row of suckers.

** Not finned.*

ELEDONE. Body rounded, without fins. Third right arm hectocotylized.

BOLITÆNA. More gelatinous than Eledone; suckers smaller, less developed.

** * Finned.*

CIRROTEUTHIS. Body with two transverse medial fins; mantle united to the head nearly all round, by a cervical band; arms united by a web nearly to their tips.

c. Arms with three rows of suckers.

TRITAXEOPUS.

OCTOPUS, Lamarck, 1799.

Etyim.—*Octo*, eight; *pous* (*poda*), feet. *Poulpe*.

Syn.—*Polypus*, Leach, 1817.

Distr.—44 species. Coasts of temperate and tropical seas. *O. Cuvieri*, d'Orb. (xxiii, 5); *O. octopodia*, Linn. (xxiii, 1).

Animal with a rounded body, not finned at the sides or extremity; the eight long arms provided on their inner surface with two rows of sessile fleshy suckers; mantle-support fleshy. Shell represented by two short cartilaginous stylets enclosed in the tissues of the mantle. The third right arm of the male is altered for sexual purposes.

Verany says, that although the Octopus usually hides itself in the crevices of rocks, which the elasticity of its body enables it to do with great facility, it sometimes frequents sandy bottoms. On these occasions, as he has several times observed, it covers itself with *debris* by means of its suckers, and thus hid, patiently awaits its prey. The Poulpes are fished by means of an edible morsel, attached to a line and slowly moved about their retreat. An individual having enveloped the bait in his arms, is gently drawn sufficiently near to the fisherman to enter a small hand-net. In summer, the young octopods are caught by means of a line armed with several hooks garnished with red cloth. By quickly drawing in the line, the animals may be captured. This is considered a fine pastime for the fine summer evenings at Nice. The Octopus retains his vitality for a long time out of the water, so that the fisherman is compelled to kill him at once with his knife, to prevent escape.

The meat of the Octopus has a well-marked taste, and is excellent when young. It is regularly sold by fishermen in the markets of Southern Europe. A section of an arm shows a white, firm flesh, resembling in appearance steaks of halibut.

The largest Octopus seen by Verany was over three yards in length, and weighed 25 kilogrammes; it was captured by a fisherman with his hands only, after a fatiguing struggle.

The action of the suckers of the Poulpe upon the skin, the serpentine motion and muscular force of its arms, and its hideous aspect, have caused to be exaggerated, says M. Verany, the misdeeds of this cephalopod, which is stupid and incapable of harm.

Mr. Jeffreys, in his admirable "British Conchology," states that the Octopus feeds principally on bivalves. The heaps of shells around their dens, which are uncovered during the recess of spring tides at Herm, are enormous; in one of these heaps, more than two thousand shells were counted, principally species of *Tapes*.

Lord's "Naturalist in British Columbia" contains the following account of the Octopus:

"The ordinary resting-place of this hideous sea-beast is under

a large stone, or in the wide cleft of a rock, where an Octopus can creep and squeeze itself with the flatness of a sand-dab, or the slipperiness of an eel. Its modes of locomotion are curious and varied; using the eight arms as paddles, and working them alternately, the central disk representing a boat, octopi row themselves along with an ease and celerity comparable to the many-oared caïque that glides over the tranquil waters of the Bosphorus; they can ramble at will over the sandy roadways, intersecting their submarine parks, and converting arms into legs, march on like a huge spider. Gymnasts of the highest order, they climb the slippery ledges, as flies walk up a window-pane; attaching the countless suckers that arm the terrible limbs to the face of the rocks, or to the wrack and sea-weed, they go about back downward, like marine sloths, or, clinging with one arm to the waving algæ, perform series of trapeze movements that Leô tard might view with envy.

"I do not think, in its native element, an Octopus often catches prey on the ground or on the rocks, but waits for them just as the spider does, only the Octopus converts itself into a web, and a fearful one too. Fastening one arm to a stout stalk of the great sea-wrack, stiffening out the other seven, one would hardly know it from the wrack amongst which it is concealed. Patiently he bides his time, until presently a shoal of fish come gaily on. Two or three of them rub against the arms: fatal touch! As though a powerful electric shock had passed through the fish, and suddenly knocked it senseless, so does the arm of the Octopus paralyze its victim; then winding a great sucker-clad cable round the palsied fish, he draws the dainty morsel to the centre of the disk, where the beaked mouth seizes, and soon sucks it in.

"I am perfectly sure, from frequent observations, the Octopus has the power of numbing its prey; and the sucking disks along each ray are more for the purposes of climbing and holding on whilst fishing, than for capturing and detaining slippery prisoners.

"The Indian looks upon the Octopus as an alderman does on turtle, and devours it with equal gusto and relish, only the savage roasts the glutinous carcase instead of boiling it. His mode of catching octopi is crafty in the extreme, for redskin well knows, from past experience, that were the Octopus once to get some of its huge arms over the side of the canoe, and at the same time a holdfast on the wrack, it could as easily haul it over as a child could upset a basket. Paddling the canoe close to the rocks, and quietly pushing aside the wrack, the savage peers through the crystal water, until his practised eye detects an Octopus, with its great rope-like arms stiffened out, waiting patiently for food. His spear is twelve feet long, armed at the end with four pieces of hard wood, made harder by being baked and charred in the

fire : these project about fourteen inches beyond the spear-haft, each piece having a barb on one side, and are arranged in a circle round the spear-end, and lashed firmly on with cedar-bark. Having spied out the Octopus, the hunter passes the spear carefully through the water until within an inch or so of the centre disk, and then sends it in as deep as he can plunge it. Writhing with pain and passion, the Octopus coils its terrible arms round the haft ; redskin, making the side of his canoe a fulcrum for his spear, keeps the struggling monster well off, and raises it to the surface of the water. It is dangerous now ; if it could get a hold-fast on either savage or canoe, nothing short of chopping off the arms piecemeal would be of any avail.

“ But the wily redskin knows all this, and has taken care to have another spear, unbarbed, long, straight, smooth, and very sharp, and with this he stabs the Octopus where the arms join the central disk. I suppose the spear must break down the nervous ganglions supplying motive power, as the stabbed arms lose at once strength and tenacity ; the suckers, that a moment before held on with a force ten men could not have overcome, relax, and the entire ray hangs like a dead snake, a limp, lifeless mass. And thus the Indian stabs and stabs, until the Octopus, deprived of all power to do harm, is dragged into the canoe, a great, inert, quivering lump of brown-looking jelly.”

Mrs. Lucie L. Hartt thus relates her experience with an Octopus :

“ It was during my first visit to Brazil, that one day, while busily engaged in examining a reef at a little town on the coast called Guarapary, my eye fell on an object in a shallow tide-pool, packed away in the crevice of the reef, which excited my curiosity. I could see nothing but a pair of very bright eyes ; but, concluding that the eyes had an owner, I determined very rashly to secure him. I had been handling corals, and seemed to have forgotten that all the inhabitants of the sea are not harmless. I put my hand down very quietly so as not to ruffle the water, when, suddenly, to my surprise, it was seized with a pressure far too ardent to be agreeable, and I was held fast. I tugged hard to get away, but this uncivil individual, whoever he was, evidently had as strong a hold on the rocks as he had on my hand, and was not easily to be persuaded to let go of either. At last, however, he became convinced that he must choose between us, and so let go his hold upon the rocks, and I found clinging to my right hand, by his long arms, a large octopod cuttle-fish, and I began to suspect that I had caught a Tartar. His long arms were wound around my hand, and these arms, by the way, were covered with rows of suckers, somewhat like those with which boys lift stones, and escape from them was almost impossible. I

knew that this fellow's sucking propensities were not his worst ones, for these cuttle-fishes are furnished with sharp jaws, and they know how to use them too, so I attempted to get rid of him. But the rascal, disengaging one slimy arm, wound it about my left hand also, and I was a helpless prisoner. In vain I struggled to free myself—he only clasped me the tighter. In vain I shouted to my companion—he had wandered out of hearing. I was momentarily expecting to be bitten, when the “bicho” suddenly changed his mind. I was never able to discover whether he was smitten with remorse and retired with amiable intentions, or whether he only yielded to the force of circumstances. At any rate he suddenly relinquished his hold upon my hands and dropped to the sand. Then raising himself on his long, limsy arms, he stalked away towards the water, making such a comical figure, that, in spite of my fright, I indulged in a hearty laugh. He looked like a huge and a very tipsy spider, staggering away on his exceedingly long legs.

“Cuttle-fishes are sometimes used for food by the Brazilians, and different species may be seen in the markets, where one frequently finds them still alive. Sometimes, as he stoops to examine one, its body is suddenly suffused with a deep pinkish glow. Before he has time to recover from his surprise, this color fades, and a beautiful blue takes its place as rapidly as a blush sometimes suffuses a delicate cheek. The blue, perhaps, is succeeded by a green, and then the whole body becomes pink again. One can hardly conceive anything more beautiful than this rapid play of colors, which is produced by the successive distention of sets of little sacks containing fluids of different colors, which are situated under the skin.”—*American Naturalist*, iii, 256, 1870.

“The British Vice-Consul, Green, in a recent report, furnishes some novel and interesting particulars as to the fishing and trade in cephalopods in the Tunis waters. Octopodia and polypi are the trade names under which these cephalopods are known in the Levant and Greek markets, where they are solely imported for consumption during Lent, the orthodox Church not including them in the prohibition against the use of flesh in seasons of religious abstinence.

“They prefer rocky shallows, and visit these waters, coming from the open sea in the months of January, February and March. A considerable number of octopodia, however, remain permanently near the shores; but it has been observed that when their fry, locally called ‘muschi,’ are numerous from the month of June to August, the fishing of the coming season is sure to be abundant, whilst the reverse is the case if they appear in numbers in November and December. In a good season, the

several villages on the Island of Karkenah supply about 3000 cwts., and the Jubah waters a third part of this quantity. On the shores from the village of Luesa to that of Chenies, in the Gulf of Khabs, the natives collect from 4 to 5 cwts. of cuttle-fish a day, during the season; but this supply generally serves for the consumption of the regency.

"The Tunisian Government claims a third of all the polypi fished upon its coast. The selling price varies from 25 to 50 shillings per cwt. Polypi are prepared for exportation by simply salting and drying them. Malta receives the largest share of the Tunisian polypi, but they are only sent to that island for ultimate transportation to Greece and other parts of the Levant.

"Portugal is one of the few countries that competes with Tunis in supplying the Greek markets with polypi. In Greece they are either sold after being pickled, at from £12. 16s., to £15. 9s., the cantar of 176 lbs., or in their original dried state, at £12 to £14, but these prices fluctuate according to the results of the season's fishing.

"Polypi are taken in deep water by means of earthen jars strung together and lowered to the bottom of the sea, where they are allowed to remain for a certain number of hours, and in which the animals introduce themselves. Frequently from eight to ten polypi are taken from every jar at each visit of the fishermen. In less deep water earthenware drain-pipes are placed side by side, for distances frequently exceeding half a mile in length, and in these also they enter, and are taken by the fishermen. As they are attracted by white and all smooth and bright substances, the natives deck places in the creeks and hollows in the rocks, with white rocks and shells, over which the polypi spread themselves, and are caught from four to eight at a time. But the most successful manner of securing them is pursued by the inhabitants of Karkenah, who form long lanes and labyrinths in the shallows, by planting the butt-ends of palm branches at short distances from each other, and these constructions extend over spaces of two or more miles. On the ebb of the tide (the fall is here about 10 feet) the octopodia are found in the pools inside the enclosures, and are easily collected by the fishermen, who string them in bunches of fifty each, and from eight to ten of these bunches, called 'risina,' are secured daily during the season, by every boat's crew of four men."—SIMMONDS, *Commercial Products of the Sea*.

AMPHIOCTOPUS, Fischer, 1882. Proposed for *O. membranaceus*, Quoy, the body of which is provided with a thin membrane on either side, not reaching its extremity.

PTEROCTOPUS, Fischer, 1882. Arms united to their extremity by a membrane. *O. tetracirrhus*, Delle Chiaje. Mediterranean

CISTOPUS, Gray, 1849.

Distr.—Only two species known; Celebes, India, Patagonia. *C. Indicus*, Rüppell (xxiii, 6).

Body without fins; arms with two rows of sessile suckers; upon the web connecting the arms is a bag opening by a small pore between each pair of arms.

SCÆURGUS, Troschel, 1857.

Distr.—Two species; Mediterranean Sea.

Body oval, wider than the head; arms short; cups or suckers with narrow bases. Third left arm hectocotylized.

As the principal character on which this genus is founded, is the hectocotylized arm of the male, it is sometimes impossible to ascertain whether specimens belong to this genus or to *Octopus*. It is very probable that some of the species described under *Octopus* should be placed here.

ALLOPOSUS, Verrill, 1880.

Distr.—*A. mollis*, Verrill (xxiv, 13). 100 m. S. of Newport, R. I.

Allied to *Philonexis* and *Tremoctopus*. Body thick and soft, smooth; arms united by a web nearly to the ends; suckers in two rows, sessile; mantle firmly united to head by a ventral and two lateral commissures and by a broad dorsal band; siphon short, well forward. Right arm of third pair hectocotylized in the male, and developed in a sac in front of the right eye.

PINNOCTOPUS, Orb., 1845.

Finned Octopus.

Distr.—*P. cordiformis*, d'Orb. (xxiv, 12). New Zealand.

Body like *Octopus* but finned; arms with two rows of suckers.

ELEDONE, Leach, 1817.

Syn.—*Polypus*, Owen. *Moschites*, Schneider, 1784. *Ozæna*, Raf., 1814.

Distr.—Three species; Norway, Britain, Mediterranean Sea. *E. Aldrovandi*, Chiaje (xxiv, 11).

Body rounded, without fins; the arms with a single row of suckers. Third right arm hectocotylized.

E. moschatus inhabits from 10 to 100 metres in depth, rocky as well as sandy shores of the Mediterranean Sea; it appears in the markets of Genoa in quantities from September to May. It is able to throw itself out of the water to a distance of 8 or 10 feet, and can also eject water from its funnel for over a foot. Verany has seen it repeat this jet eight times, taking six to eight respirations between each jet.

Notwithstanding its musky odor, this species is largely used for food; some skin it, and others use seasoning to diminish this

odor. Its flesh is more tender than that of the Octopus, but it has less taste and is not so well liked. It is used boiled, as a salad, fried or as a ragoût.

The women of the tribe of M'talassa (Algiers), anoint their hair with the black liquid which they collect from this mollusk, but whether they use it as a dye or for the sake of its musk-like perfume, is not known. The perfume appears to be capable of industrial use.—AUCAPITAINE, *Rev. et Mag. Zool.*, 366, 1862.

Johnston says of *E. octopodia*, a species common in Northern Europe: "When at rest, this octopod lies prone on the belly, the arms spread out in front, with their extremities exposed in spirals on the sides. It has in this position a considerable likeness to a toad; and, often raising the back and head, its aspect is really repulsive and threatening. It moves quickly, and always retrograde, playing its arms in a regulated, graceful manner, which no one can contemplate without wonder in a body so grotesque and apparently so inapt for locomotion."—*Proc. Berw. N. H. Club*, i, 198.

BOLITENA, Steenstrup, 1850.

More gelatinous than Eledone; suckers smaller, less developed.

In the description of this genus no type is cited. In Woodward and Keferstein a single living species is mentioned, but without name.

CIRROTEUTHIS, Eschricht, 1836.

Etym.—*Cirrus*, a filament, *teuthis*, a cuttle-fish.

Syn.—*Bostrychoteuthis*, Agass., 1847. *Sciadephorus*, Rein. and Proch., 1846.

Distr.—*C. Mulleri*, Esch. (xxiii, 7). Greenland.

Body with two transverse medial fins; mantle united to the head nearly all round, by a cervical band; arms united by a web nearly to their tips.

STAUROTEUTHIS, Verrill, 1879. Allied to Cirroteuthis, but with the mantle united to the head all around, and to the dorsal side of the slender siphon, which it surrounds like a close collar, leaving only a very narrow opening around the base of the siphon laterally and ventrally. Fins triangular, in advance of the middle of the body. Dorsal cartilage forming a median angle directed backward. Body flattened, soft, bordered by a membrane. Eyes covered by the integument. Web not reaching the tips of the arms. Suckers in one row. Right arm of second pair is altered, in the male, at the tip. *S. Syrtensis*, Verrill. Near Sable Island.

TRITAXEOPUS, Owen, 1881.

Distr.—*T. cornutus*, Owen (xxiii, 10). Australia.

Body not finned; suckers on the arms three-ranked.

FAMILY TREMOTOPIDÆ.

TREMOTOPUS, Chiaje, 1830.

Etym.—*Tremata*, pores, and *Octopus*.*Syn.*—*Philonexis*, d'Orb., 1835.*Distr.*—6 species; Mediterranean, Atlantic, N. Pacific, Mauritius. *T. violaceus*, Chiaje (xxiii, 8).

Body rounded, head large, band of the neck very small. Funnel short. Two aquiferous pores in the neck. Third right arm hectocotylized, fringed on the sides, and developed in a sack-like aperture on the side of the head. Two first pairs of arms united by a web in the female (not in the male), other arms free.

PARASIRA, Steenstrup, 1861.

Distr.—2 sp.; Mediterranean. *P. catenulata*, Fer. (xxiii, 9).

Body rounded; head small and short; neck band rather broad. Funnel long. No water-pores in the neck, two at the base of the siphon. Third right arm hectocotylized, not fringed, developed from a pedicelled sack. Male very different from the larger female.

The flesh of this mollusk is tough and unwholesome, and for these reasons is not sold in the Italian markets. The Genoese fishermen make of the skin of the body a sort of cap, whereof the reticulations serve as ornaments.

HALIPHRON, Steenstrup, 1858.

Arm only known. With bell-shaped cups, having lily-like borders.

Described from a single arm found in the stomach of a shark. No species characterized.

FAMILY ARGONAUTIDÆ.

ARGONAUTA, Linn., 1756.

Argonaut, or *Paper Nautilus*. *Argonautai*, sailors of the ship Argo. *Syn.*—*Ocythoë*, Leach (not Rafin.), 1817.

Distr.—9 sp. All warm seas. *A. Argo* (xxiv, 18) is found in the tropical Pacific, Indian and Atlantic Oceans; Gulf of California, Mediterranean, Cape of Good Hope. *Fossil*, 2 species, Tertiary of Europe.

Characters, those of the family (p. 12). The third right arm of the male is hectocotylized.

The *shell* of the Argonaut is thin and translucent; it is not moulded on the body of the animal, nor is it attached by shell-muscles; and the unoccupied hollow of the spire serves as a receptacle for the minute clustered eggs (xviii, 15). The shell

is peculiar to the female: its special function is for the protection and incubation of the eggs. It is not homologous with the chambered or internal rudimental shells of other cephalopods, but may be compared with the cocoon of the leech, or the float of *Ianthina*. The Argonaut sits in its boat with its siphon turned towards the keel, and its sail-shaped (dorsal) arms closely applied to the sides of the shell. It swims by ejecting water from its funnel, and crawls in a reversed position, carrying its shell over its back like a snail.

The male Argonauts (xvi, 84, 85), are one inch in length, and possess no shell; their dorsal arms are pointed, not expanded. The testis is large, and like that of the Octopus in structure and situation; it contains spermatozoa of different degrees of development, and the excretory duct probably debouches into the hectocotylus.

A living Argonaut was captured at Long Branch, New Jersey, by a fisherman, in August, 1876. It was kept alive for eight or nine days and made feeble attempts to swim in its narrow confinement (*Am. Nat.*, xi, 243). Numbers of fresh shells have been recently dredged, about 90 miles south of Narraganset Bay, R. I., by the U. S. Fish Commission.

The occurrence of the Argonaut on the Florida coast, in one instance with the animal entire, is mentioned in *Am. Nat.*, xii, 397.

Dr. H. Müller observes that the female Argonaut appears periodically in great numbers at Messina during the spawning season, but at other times her usual habitat is at the bottom in deep waters. The male is always very small, and is rarely met with: its hectocotylized arm is detached during coition and is found in the mantle of the female, where it enjoys a prolonged separate life, although unprovided with digestive organs. The young female an inch in length, has no shell; it is developed later.

In South Australia, at certain seasons of the year, during the prevalence of strong northerly winds, the shells of the female Argonaut are washed ashore in considerable numbers. Many of these shells contain the animal in a living state; but they soon fall a prey to the sea-gulls, by whom they are greedily devoured.

SUBORDER II. *DECAPODA*.

Body oblong, laterally finned; arms consisting of eight normal (sessile) ones, and two longer or tentacular arms, which are contractile or retractile; suckers provided with corneous rings, sometimes armed with teeth, or with hooks; shell dorsal, internal. One or two of the sessile arms are modified for copulation.

FAMILY LOLIGINIDÆ.

Loligo (Pliny), Lamarek, 1801.

Calamary. Syn.—Pteroteuthis, Blainv.

Distr.—31 sp.; all seas, Norway, United States, New Zealand.
L. Pealii, Lesueur (xxv, 20–22).

Body long, with posterior rhombic fins united behind; mantle supported by a cervical ridge and by cup-like cartilages on the base of the funnel or siphon; siphon valved, attached by bands to the head; arms with two rows of suckers provided with horny, dentated rings; tentacular arms with four rows of suckers on their clubs. Fourth left arm hectocotylized at its extremity. Gladius feather-like, its shaft keeled on the ventral side.

The calamaries are good swimmers; they are found in all parts of the world. Owen mentions that the pens are sometimes duplicated in old specimens, several being found packed closely, one behind another. The suckers on the margins of the projections of the buccal membrane are doubtless additional prehensile organs very useful in assisting in holding the food to the mouth. There appear to be two types of form in the gladius or internal shell: that in which the wings are expanded, with convex margins, and that in which they are narrow, with nearly straight margins.

The so-called artificial eyes of the ancient Indian mummies of Arica, Peru, are, according to Tschudi, the dried eyes of *Loligo gigas* inserted in lieu of the natural organs. According to Verrill, numbers of the young of the American *Loligo Pealii* are often found in the stomach of the red jelly-fish. Of *L. pallida*, a closely allied or identical species, Mr. Verrill says: "These squids are eagerly devoured, even when full-grown, by many of the larger fishes, such as blue-fish, black-bass, striped-bass, etc. When young they are preyed upon by a still larger variety of fishes. It is often taken in the seines in large numbers with menhaden, upon which it probably feeds."

On the 30th of November, 1860, the French steamer *Alecton*, commanded by Lient. Bouyer, encountered, between Madeira and Teneriffe, an enormous Poulpe, which was swimming on the surface of the water. The animal measured 15 to 18 feet in length, without counting the formidable arms, covered with cups, which crowned its head. Its color was brick-red; its eyes had a prodigious development and frightful fixity. Its mouth, like the beak of a parrot, could be opened to the extent of 18 inches. Its body, fusiform but much swelled towards the centre, presented an enormous mass, the weight of which has been estimated at more than 4400 pounds. Its fins, situated at the posterior extremity, were rounded in two fleshy lobes and of

very large size. The commander of the vessel, on perceiving it, halted upon his course and made preparations for capturing the monster. Guns were charged and harpoons hastily prepared; but at the first discharge of the former, the animal dived under the ship and immediately appeared on the other side. Attacked again with harpoons, it disappeared two or three times, and, each time that it reascended to the surface, its long arms writhed. The ship followed or arrested its course according to the movements of the animal. This chase lasted more than three hours. The commander of the *Alecton* was determined to capture this new kind of enemy; nevertheless he did not dare to lower a boat, for a single arm of this cephalopod would suffice to overturn it. The harpoons which were launched at it penetrated the flabby flesh and came out without success; several balls traversed it also unsuccessfully. Nevertheless it received one of them which appeared to wound it badly, causing it to vomit a great quantity of frothy matter and blood mixed with viscid matter which spread a strong odor of musk. It was at this instant that they succeeded in lassoing the animal, but the rope slid along the elastic body until arrested by the fins. Attempting to haul their prize aboard, they had already raised the greater part of the animal from the water when its enormous weight caused the rope to penetrate the flesh and separate the posterior portion of the body—which was drawn on board, whilst the rest disappeared in the sea.

The above is condensed from a letter addressed to M. Moquin-Tandon, by M. Sabin Bertholet, consul of France, at the Canaries, who saw the fragment alluded to, and received the relation of the commandant of the vessel. One of the officers made a sketch of this animal, which, in conjunction with the description, is considered by Messrs. Crosse and Fisher sufficiently exact to warrant them in determining it to belong to a new species of *Loligo*, which they name *L. Bouyeri*. The figure and description show but eight arms, but the elongated form of the body, the proportional shortness of the arms and the presence of the posterior fins, show it to have been one of the decapods. Probably the tentacular arms were either deficient or were not seen.

LOLIGUNCULA, Steenstrup, 1881. Swimming lobes thick, wide and very short, forming together a transverse oval; female receiving the spermatophores upon the interior wall of the mantle, alongside the left branchia. *L. brevis*, Blainv. (xxv, 23). Characters perhaps insufficient.

TEUTHIS, Gray, 1849. Buccal membrane without suckers. A single European species, *L. media*. It was known to Aristotle and the ancients; and is highly esteemed for food in Italy.

LOLIOLUS, Steenstrup, 1856.

Distr.—3 species; Gulf of California, Indian Ocean. *L. affinis*, Steenst. (xxv, 30).

Body rather long, with posterior round fins united behind; siphon not attached to the head. Fourth left arm hectocotylized in its entire length. Gladius feather-like, broad. Otherwise as in *Loligo*.

Loligo hemiptera, *L. brevipinna*, and other *Loligines* with blunt extremity and round fins, may perhaps belong to this small group, which is not widely separated by its characters from *Loligo*.

SEPIOTEUTHIS, Blainv., 1824.

Syn.—Chondrosepia, Leuck, 1826.

Distr.—14 species; West Indies, Cape, Red Sea, Java, Australia, Mediterranean, Madagascar, Sandwich Islands. *S. Stenodactyla*, Grant (xxv, 24). *S. lunulata*, Fer. Orb. (xxv, 25).

Body rather long or oval, with small lateral fins extending its entire length; siphon attached to the head by muscular bands; buccal skin with seven projections covered with suckers; a strong wrinkle behind the eyes. Fourth left arm hectocotylized at its extremity. Otherwise like *Loligo*.

TEUTHOPSIS, Deslongchamps, 1835.

Etym.—*Teuthis*, a calamary, and *opsis*, like.

Distr.—A few species known, fossil in the lias of France and Wurtemberg. *T. Bunnellii*, Desl. (xxviii, 55, 56).

Pen or gladius dilated and spatulate behind, its wings curved towards the ventral side somewhat spoon-like.

LEPTOTEUTHIS, Meyer, 1834.

Etym.—*Leptos*, thin, and *teuthis*, a calamary.

Distr.—*L. gigas*, Meyer (xxviii, 57). Oxford clay, Solenhofen.

Shaft of the pen enlarging from a point to a broad blade in front, with long, lateral wings starting from the posterior pointed end.

BELEMNOSEPIA, Agassiz, 1836.

Syn.—Belopeltis, Voltz; Geoteuthis, Münster, 1843; Loligosepia, Queenst., 1839; Palæosepia, Theodori, 1844.

Distr.—9 sp. Fossil, in the Upper Lias of Wurtemberg, Calvados and Lyme Regis. *B. lata*, Münster. (xxviii, 63).

Gladius like *Leptoteuthis* and perhaps not separable from it. The shaft is more triangular, and the lateral wings broader, with more rounded outlines.

Besides the pens of this calamary, the ink-bag, mantle and bases of the arms, as well as the horny shells, are preserved. Some of the ink-bags are nearly a foot in length, and are invested

with a brilliant nacreous layer. So indestructible is this fossil ink that it is yet capable of use as Sepia. It is difficult to understand how it was preserved, as the recent calamaries spill their ink on the slightest alarm.

BELOTEUTHIS, Münster, 1843.

Etym.—*Belos*, a dart, and *teuthis*. *Syn.*—Sepiolites, Münster.

Distr.—*B. subcostata*, Münster. (xxviii, 58). Upper Lias of Wurtemberg.

Gladius. Shaft lozenge-shaped, pointed at each end, with posterior lateral wings.

PHYLLOTEUTHIS, Meek and Hayden, 1860.

Distr.—*P. subovata*, M. and H. (xxviii, 59). Upper Cretaceous, Dakota.

Gladius thin, subovate, slightly concave below, and convex above. From behind the middle it narrows towards the front, the outline of the lateral margins being convex, while the posterior end is more or less obtusely angular.

This genus is founded on the impression of the expanded part of a gladius in a mass of rock; it was evidently thin, and as no part of its substance remains, is supposed to have been corneous. It looks very like *Beloteuthis*.

PTILOTEUTHIS, Gabb, 1869.

Distr.—*P. foliatus*, Gabb (xxviii, 60). Cretaceous, California.

Gladius elongate, subovate, very thin, anterior end broadly angulated, no midrib; surface marked by numerous, irregular, small wrinkles, which radiate backwards and outwards, partly from the anterior end, and partly from an imaginary median line.

[**SCAPTORRHYNCHUS**, Bellardi.]

Founded on decapod beaks discovered in the tertiary of Piedmont. *S. miocenicus*, Bellardi (xxviii, 75–77).

FAMILY SEPIOLIDÆ.

SEPIOLA, Leach, 1817.

Syn.—Sepioloidea, d'Orb, 1839. Fidenas, Gray, 1849.

Distr.—7 sp. European Seas, Japan, Mauritius, Viti Is., Australia, Singapore, Coast of Maine, U. S.

Body short, purse-like, mantle united to the head cervically, and ventrally supported by a ridge fitting a groove on the funnel; arms with two or eight rows of pedunculated suckers, the rings of which are not toothed, and eight rows of very small ones on the tentacular clubs. Fins oval, dorsal. Gladius lancet-form, only half as long as the body, margins thickened. First left arm hectocotylized.

Mr. Alder says of *S. Sepiola*, the common European species: "This is an odd fish, crouching generally at the bottom like a toad, with its great goggle-eyes half closed, and sometimes crawling along by means of its suckers, puffing the water through the funnel all the time. When it does take to swimming, it darts very quickly through the water, and is difficult to catch. When taken out of the water and placed on the hand, it had recourse to an odd mode of progression, turning two or three somersets in tumbler-fashion, first laying hold with its arms, turning over and laying hold again until it managed to get back into the water." It is said by Mr. Gosse, to burrow in the sand by blowing through its funnel, and using its arms, with their suckers, to remove small stones and gravel. They spawn towards the end of May or beginning of June. The eggs are arranged in the centre of a bluish gelatinous mass, as if around an axis, and fifteen to thirty of these masses, each containing from forty to one hundred and thirty eggs, are united, each by a basal stalk, to form a group attached upon some submarine body. The fry is hatched in twenty-two to twenty-five days. They visit the Algerine coast in numerous troops during the month of May, for the purpose of spawning. In the Mediterranean it is found at depths of 60 to 200 mètres, where it lives in company with the *Eledones*. Largely consumed as food in Italy; it is much esteemed for the delicacy of its flesh.

S. Penares, Gray, the type of Gray's genus *Fidenas*, does not appear to possess any distinctive characters, except that the suckers are long-peduncled, and the peduncles are constricted on the upper part. The only specimen is in spirits, and is in a mutilated state.

ROSSIA, Owen, 1834.

Dedicated to Capt. John Ross, the Arctic voyager.

Syn.—*Heteroteuthis*, Gray, 1849.

Distr.—10 sp. Arctic Seas, Great Britain, Massachusetts Bay, Mediterranean. *R. Owenii*, Ball (xxv, 27).

Generally like *Sepiola*, but the mantle is supported cervically by a ridge; arms with two or four rows of sessile suckers. First left arm and middle of first right arm hectocotylized. Shell lancet-form, small.

Owen thinks that the eyelids discovered in *Rossia palpebrosa*, and from which it derives its name, are a peculiar organization designed as a defense for the eyes against the spicular ice crystals, which, in the summer season, crowd the northern waters.

The eggs of *Rossia* are laid singly, one alongside of another, and fixed solely by their viscous surface.

SEPIADARIUM, Steenstrup, 1881.

Distr.—*S. Kochii*, Steenstrup (xxv, 29). Japan.

Dorsal lamina or pen absent. Cartilaginous support wanting, the mantle and siphon being united by a muscular ligament; mantle border joined dorsally to the neck.

IDIOSEPIUS, Steenstrup, 1881.

Distr.—*I. pygmæus*, Steenstrup (xxv, 26). Indian Ocean.

No dorsal lamina or pen, but instead of it there is, under the mantle, a singular ring-like tendinous support; cartilage-button oval, with corresponding fosset.

STOLOTEUTHIS, Verrill, 1882.

Distr.—*S. leucoptera*, Verrill. Off Martha's Vineyard, Mass.

Body short and thick, well rounded; head large, united to mantle by a broad dorsal commissure; eyes large, pupils round; eyelids free all around; no pen; mantle thick, extending farther forward beneath than laterally; fins large, lateral; siphon with an internal valve in both sexes; connective cartilages long, with a central groove, fitting a linear ridge on each side of the mantle; arms webbed for more than half their length, except between the ventral arms; second pair in the male, and some females, with two or three much enlarged suckers near the middle.

INIOTEUTHIS, Verrill, 1882.

Distr.—2 sp. Japan.

Body, lateral fins, and dorsal commissure of mantle as in *Sepiola*; lateral connective cartilages of the siphon oblong-elliptical, with the groove open behind, fitting a linear ridge on each side of the mantle; eyelids free below, adherent above; pen absent; arms webbed only slightly at base; suckers both on sessile arms and tentacles, as in *Rossia*; left dorsal arm hectocotylized.

FAMILY CRANCHIIDÆ.

CRANCHIA, Leach, 1817.

In honor of *J. Cranch*, naturalist to the Congo expedition.

Distr.—3 sp. Congo, Africa; West Indies. *C. scabra*, Leach (xxv, 28).

Characters generally those of the family. Body short, rounded; fins very small, rounded, terminal; buccal membrane produced into eight lobes; arms short, with two rows of suckers; tentacular clubs finned behind, with suckers in eight rows. Siphon valved.

In *C. megalops*, the body is joined to the head by a pseudo-articulation; for which Prosch proposes the subgeneric name *Owenia*, 1847.

LOLIGOPSIS, Lamarck, 1812.

Etym.—*Loligo*, and *opsis*, like.

Syn.—Leachia, Lesueur, 1821; Taonius, Steenstrup, 1861; Desmoteuthis, Verrill, 1882.

Distr.—8 sp., pelagic. Northern Atlantic, Mediterranean, Indian and Pacific Oceans, Japan. *L. guttata*, Grant (xxvi. 35).

Body long, attenuated behind, with large fins; siphon not valved; tentacles long and slender.

PEROTIS, Esch., 1827. Sides with rows of acute tubercles; shell with solid tip. 2 sp.; Indian Ocean, tropical Atlantic.

FAMILY CHIROTEUTHIDÆ.

CHIROTEUTHIS, Orb., 1839.

Etym.—*Cheir*, the hand, and *teuthis*, a calamary.

Distr.—2 sp. Atlantic and Mediterranean; on gulf-weed. *C. Veranyi*, Fer. (xxvi, 31, 32).

Body long, attenuated; arms long, connected by a short basal web, with two rows of small, long-pedunculated suckers; tentacles very long and narrow, covered their whole length with scattered suckers, the clubs with four rows of long-pedunculated suckers. Pen slender in the middle, slightly winged at each end.

The great cephalic development of the animals of this very restricted genus, the immense length of the tentacles and the peculiar armament of their clubs, and the gladius expanded at each end, form excellent distinctive characters from the Loligopsidæ.

CALLITEUTHIS, Verrill, 1880. Body short, tapering to a free tip; fins small, united behind; siphon united to head by two dorsal bands, and having an internal valve; mantle connected to sides of siphon by lateral elongated cartilages and grooves; arms long, free, suckers in two rows, largest in middle of lateral and dorsal arms; eyes large, with oval openings; buccal membrane simple, sack-like; pen broad, lanceolate. *C. reversa*, Verrill (xxiv, 14). New England.

BRACHIOTEUTHIS, Verrill, 1882.

Distr.—*C. Beanii*, Verrill. Off Martha's Vineyard, Mass.

Allied to Chiroteuthis; differs in having the lateral connective cartilages of the siphon simple, long-ovate, and the corresponding cartilages of the mantle in the form of simple, linear ridges; a rhombic caudal fin; pen with a simple, linear, anterior portion, suddenly expanding into a much broader, lanceolate, posterior portion, which is naturally infolded; arms slender, the ventral ones not distinctly obliquely compressed; tentacular club with a spoon-like cavity at tip.

HISTIOTEUTHIS, d'Orbigny, 1839.

Etym.—*Histion*, a veil, and *teuthis*, a calamary.

Distr.—3 sp. Mediterranean Sea; off Nova Scotia. *H. Bonelliana*, Fer. (xxvi, 33, 34).

Body short, cylindrical; head long; arms long, the three superior pairs connected by a largely developed web, the ventral pair free; tentacles long, with six rows of dentated cups on their clubs; buccal membrane six-lobed. Pen short and broad.

FAMILY THYSANOTEUTHIDÆ.

THYSANOTEUTHIS, Troschel, 1857.

Etym.—*Thysanos*, a fringe, and *teuthis*, a calamary.

Distr.—2 sp. Mediterranean Sea. *T. rhombus*, Trosch. (xxvi, 36, 37).

Body with large triangular fins the whole length of each side; arms with lateral expansion of the skin, and two rows of pedunculated suckers, from which spring threads which are connate with the surface of the lateral expansions. Shell file-shaped.

FAMILY ONYCHOTEUTHIDÆ.

The principal character of this family is the development of hooks upon the arms, as a means of prehension; they replace the sucking disks to a greater or less extent, according to the several genera. A few fossil forms occur.

GONATUS, Gray, 1849.

Distr.—*G. amœna*, Möll. (xxvi, 38), is found on the coast of Greenland.

Body like *Loligo*; arms thick, with four rows of small suckers; tentacular clubs with many rows of small suckers, and a single large basal cup armed with a hook; siphon not connected to the head, without valve. Gladius lancet-form.

ONYCHOTEUTHIS, Lichtenstein, 1818.

Etym.—*Onyx*, a claw, and *teuthis*, a calamary.

Syn.—*Ancistroteuthis*, Gray, 1849.

Distr.—10 sp. Atlantic and Pacific O., arctic and tropical; Mediterranean. *O. Krohni*, Fer. et Orb. (xxvi, 39, 40).

Arms with two rows of suckers, the rings of which are not toothed; tentacles thick, their clubs with two rows of strong hooks, and at the base a rounded group of suckers, with which they are supposed to unite the two tentacles, and use them in conjunction as a *point d'appui*, where great strength is required in capturing their prey. Gladius lancet-form, with a conical commencement.

These animals are solitary in habit, frequenting the open sea, and especially banks of gulf-weed. Some of the species have an immense geographical distribution; as *O. Banksii*, from the Arctic Ocean to the Cape of Good Hope and Indian Ocean. The peculiar arrangement of suckers, forming a circle at the base of each tentacular club, enabling the animal to use the two clubs in conjunction when necessary, give an immense increase of power. They suggested the obstetric forceps of Professor Simpson.

ONYCHIA, Lesueur, 1821.

Syn.—Teleoteuthis, Verrill, 1882.

Distr.—2 sp. W. Indies, Coast of Chili, Indian Ocean. *O. Caribæa*, Les. (xxvi, 41).

Generally like Onychoteuthis; tentacles thin, clubs with two rows of hooks, two rows of suckers, and a circle of suckers at the base for supporting the tentacles together. Gladius feather-like.

ENOPLOTEUTHIS, d'Orbigny, 1841.

Armed Calamary. *Enoplos*, armed, and *teuthis*.

Distr.—5 sp. W. Africa, So. Pacific, Mediterranean. *E. Smithsii*, Leach (xxvii, 43). 1 fossil sp. Lithographic stone of the Upper Oxford, Eichstadt, Bavaria.

Body long, cylindrical, with triangular fins either at the end or all along both sides (*Ancistrocheirus*); arms with two rows of hooks, and with sometimes (*Abraia*) suckers at their ends; tentacles with hooks only; siphon connected with the head by bands; the fourth right or left arm hectocotylized. Shell feather-like or blade-shaped.

ABRALIA, Gray, 1849. Sessile arms with hooks below, and suckers at the tips. *Distr.*—4 sp. N. Atlantic, Indian O., Messina, Kurile Isles.

ANCISTROCHEIRUS, Gray, 1849. Fins occupying nearly the whole length of the body. *Distr.*—1 sp. Indian Ocean.

LESTOTEUTHIS, Verrill, 1880.

Syn.—Cheloteuthis, Verrill, 1881.

Distr.—*L. Kamtschatica*, Midd. Kurile Isles.

Tentacular club with numerous suckers and a few large central hooks. Sessile arms dissimilar; lower ones with four rows of suckers; upper with two central rows of hooks, and with marginal suckers on each side. Pen with a long terminal cone.

VERANIA, Krohn, 1846.

Named for Verany, author of a work on the Cephalopoda of the Mediterranean Sea.

Syn.—Octopodoteuthis, Ruppell and Krohn, 1844.

Distr.—Mediterranean. *V. Sicula*, R. and K. (xxvi, 42).

Body cylindrical, thin, rounded behind, with fins along nearly the whole length; arms with two rows of small hooks; tentacles thin, shorter than the sessile arms, with small suckers; siphon connected by bands. Shell feather-like. Too close to *Enoplo-teuthis*.

Octopodoteuthis has priority, but is rejected as inappropriate for a decapod.

PLESIOTEUTHIS, Wagner, 1860.

Distr.—2 sp. Fossil, in the Solenhofen slate: liassic. *P. prisca*, Wagner (xxviii, 66).

Body rather long, attenuated behind; arms with hooks. Shell small, lancet-form, with a central and two side ridges, and an arrow-shaped point. Huxley supposed this genus to belong to the *Belemnitidæ*, but the gladius showed neither rostrum nor phragmocone.

DORATEUTHIS, Woodward, 1883.

Type.—*D. Syriaca*, Woodward. Cretaceous, Syria.

Arms furnished with suckers and probably also with minute hooklets; the tentacular arms much longer than the sessile ones. Pen nearly as long as the body, the shaft marked by three equidistant ridges, one median and two lateral, which converge together at the very acute distal extremity; there are lateral expansions on each side, corresponding with lateral fins on the body of the animal: the latter is also provided with a terminal fin.

The form of the pen as well as that of the animal indicates resemblance to *Ommatostrephes*.

CELÆNO, Münster, 1842.

Distr.—2 fossil sp. Liassic formation of Solenhofen. *C. conica*, Wagner (xxviii, 61, 62).

Body oval; arms with hooks and suckers. Shell a rounded blade, with winged projections on either side of the pen; nucleus central.

DOSIDICUS, Steenstrup, 1856.

Distr.—The single, unfigured species, was at first believed to have been taken at Marseilles, but it is more probably West Indian.

Body long; arms with large pedunculated suckers on the lower half, and many small ones on the upper, thinner half; clubs of the tentacles with four or five hooks. Shell with a large, nearly solid end-cone.

Perhaps an abnormal specimen, with truncated and partially reproduced arms.

FAMILY OMMATOSTREPHIDÆ.

OMMATOSTREPHES, d'Orbigny, 1835.

Sagittated Calamary. *Omma*, the eyes, and *strephe*, to turn.*Syn.*—Cycria, Leach. Todarodes, Steenst., 1880. Illex, Steenst., 1880.*Distr.*—13 sp. Europe, N. Atlantic Coast of U. S., W. Indies, Cape of Good Hope, Antarctic Sea, Pacific Coast of America, Polynesia, Indian Ocean. *O. sagittatus*, Lam. (xxvii, 44, 45). Fossil: pens of 4 sp. in the Oxford clay, Solenhofen (liassic); 1 sp. tertiary.

Body long, cylindrical; arms short, with two rows of suckers; tentacles short, not retractile, the clubs with four rows of suckers; siphon valved, fastened to the head by bands. Shell small, lancet-form, with a hollow end-conus.

These animals are gregarious, frequenting the open sea in all climates. Extensively used as bait in the Newfoundland cod-fishery; they are also the principal food of the albatross, the larger petrels, the dolphins and the cachelots. They are called "sea-arrows" or "flying squids" by fisherman, on account of their habit of darting out of the water, often to such a height as to fall on the decks of vessels. The egg-masses are in large clusters, floating on the surface.

Ommatostrephes illecebrosa was observed among the wharves at Provincetown, Mass., during the month of July, engaged in capturing and devouring the young mackerel, which were swimming about in schools, and at that time were about four or five inches long. In attacking the mackerel they would suddenly dart backward among the fish, with the velocity of an arrow, and as suddenly turn obliquely to the right or left and seize a fish, which was almost instantly killed by a bite in the back of the neck, with the sharp beaks. The bite was always made in the same place, cutting out a triangular piece of flesh, and was deep enough to penetrate to the spinal cord. The attacks were not always successful, and were sometimes repeated a dozen times before one of these active and wary fishes could be caught. Sometimes, after making several unsuccessful attempts, one of the squids would suddenly drop to the bottom, and, resting upon the sand, change its color to that of the sand so perfectly, as to be almost invisible. In this way it would wait until the fishes came back, and when they were swimming close to or over the ambuscade, the squid, by a sudden dart, would be pretty sure to secure a fish. Ordinarily, when swimming, they were thickly spotted with red and brown, but when darting among the mackerel, they appeared translucent and pale. The mackerel, however, seemed to have learned that the shallow water is the safest for them, and would hug the shore as closely as possible, so that in

pursuing them many of the squids became stranded, and perished by hundreds, for when they once touch the shore, they begin to pump water from their siphons with great energy, and this usually forces them farther and farther up the beach. At such times they usually discharge their ink in large quantities. The attacks on the young mackerel were observed mostly at or near high water, for at other times the mackerel were seldom seen, though the squids were seen swimming about at all hours; and these attacks were observed both in the day and evening. But it is probable, from various observations, that this and the other species of squids are partially nocturnal in their habits, or at least are more active in the night than in the day. Those that are caught in the pounds and weirs mostly enter in the night, and evidently when swimming along the shore in schools. They are often found in the morning stranded on the beach in immense numbers, especially when there is a full moon, and it is thought by many of the fishermen that this is because, like many other nocturnal animals, they have the habit of turning toward and gazing at a bright light, and since they swim backwards, they get ashore on the beaches opposite the position of the moon. This habit is also sometimes taken advantage of by the fishermen who capture them for bait for cod-fish; they go out in dark nights with torches in their boats, and by advancing slowly toward a beach, drive them ashore.—VERRILL. *Report of U. S. Fish Commissioner for 1873*, 441.

The following notice of the Squid of the Newfoundland Banks in its relation to the American Grand Bank Cod Fisheries, is condensed from a paper by H. L. Osborn in *Am. Naturalist*, xv, 366, 1881.

The bait used in the latter part of the year is the squid *Ommatostrephes illecebrosa*. It first appears on the southern points of Newfoundland late in June or early in July. The natives and fishermen agree in opinion that the squid migrates steadily northward during the season, appearing first in the northern harbors two weeks later than in the southern, and finally lingering at northern points in the island after they have entirely disappeared from those further south.

The sole mode of capture of the squid is called "jigging," a term derived from and descriptive of the process. The only gear is a peculiar hook with a couple of fathoms of mackerel line. No bait is employed. The jig is of lead, two inches or thereabouts in length, armed at its base with sharply pointed unbarbed pins, radially arranged, and curving upward and outward. The jigging is conducted in water of from eight to ten feet, usually from small boats, but occasionally from the vessel's side. The jig is allowed to sink nearly to the bottom, where it is kept constantly vibrating up and down, till the squid is felt upon it.

Frequently two jigs are managed, one in each hand. The squid merely clasps his tentacles around the jig, and doubtless the pain from the sharp pins induces him to escape instantly, but the fisherman, who is constantly jerking the jig up and down, pulls in as rapidly as possible, entangling the animal's arms among the pins and drawing him through the water so fast that escape is impossible. The instant he emerges from the water he contracts his body, discharging through his siphon a jet of salt water. This is followed by a sucking in of the air by successive respiratory acts, till in its middle portion his cylindrical body has become almost spherical. By a second contraction the squid now ejects from his siphon a stream of his black inky secretion. Not unfrequently the luckless fisherman has not the squid unhooked before this discharge takes place and may receive the inky stream full in the face. The scene when the squid are thick is really exciting; the streams rising here and there, in twenty directions at once, point out the rapidity of the catch, and the monotonous noise of the squirt is only varied by an occasional murmur of discontent from this or that unfortunate as he lifts his querulous voice. The squid usually sell at from twenty-five to forty cents per hundred. The number used by a single vessel in only two months is astonishing. Our vessel, a small one, made three "baitings," fishing each time about two weeks and used in that time 80,000 of the squid.

A species of *Ommatostrephes* is extensively fished in Japan. Mr. Arthur Adams relates that off Nisi-Bama in the Oki Islands, he saw a number of lights moving upon the surface of the water, in all directions, which he found were used to attract the cephalopods to the surface; where they were secured by a jig, an iron shank terminated by a circle of recurved hooks. Mr. Adams visited a small fishing village near Hakodadi, where he saw hundreds of thousands of squids, cleaned and stretched on bamboo-sticks, suspended on lines to dry in the sun and air.

HYALOTEUTHIS, Gray, 1849. Body transparent, tubercular beneath; one or two cups on the second pair of sessile arms larger. *Distr.*—The only species is from the West Indies.

MOROTEUTHIS, Verrill, 1882. Pen long, narrow, thin, terminating posteriorly in a conical, hollow, many-ribbed, oblique cone, which is inserted into the oblique anterior end of a long, round, tapering, acute, solid cartilaginous terminal cone composed of concentric layers, and corresponding to the solid cone of *Belemnites* in position and relation to the true pen; elliptical connective cartilages on the base of the siphon; nuchal, longitudinal crests three, much as in *Ommatostrephes*; eyelids with a distinct sinus; caudal fin large, broad, spear-shaped; ventral arms with smooth-rimmed suckers at the base. Rest of armature unknown. *M. robusta*, Verrill.

STHENOTEUTHIS, Verrill, 1880. (Xiphoteuthis, Owen, 1881.) Distinguished by its large caudal fin, and by having a broad, membranous web along the lower side of the lateral arms, outside the suckers. *O. megaptera*, Verrill, Nova Scotia.

ARCHITEUTHIS, Steenstrup, 1857.

Syn.—Megaloteuthis, Kent; Dinoteuthis, More, 1875. Mouchezia, Vélain, 1878.

Distr.—9 sp. N. Atlantic Ocean, Alaska, Indian Ocean.

A number of gigantic cephalopods, allied to *Ommatostrephes*, have been described and referred to new genera, as above, principally on considerations of size. Verrill says that *Architeuthis* may be best distinguished from *Ommatostrephes* by the presence on the club of an irregular group of small, smooth-rimmed suckers, intermingled with rounded tubercles on each arm, the suckers on one arm corresponding with the tubercles of the other, so that by them, the two arms may be firmly attached together and thus used in concert.

In the *Manual of Conchology*, vol. i, pp. 74-91, I have given detailed accounts of some of the enormous squids found principally in the North Atlantic Ocean. The celebrated Kraken, an imaginary sea-monster, doubtless originated in the marvelous tales of an uneducated people who had seen some of these squids: so circumstantial and so well-believed was the account of the Kraken, that Linnæus found a place for it in his "Systema." Scarcely less marvelous are the well-authenticated accounts of some of these monsters encountered in modern times. The following was published in *The Zoologist*, June, 1875:

CAPTURE OF AN ENORMOUS CUTTLE-FISH OFF BOFFIN ISLAND, ON THE COAST OF CONNEMARA (IRELAND).—On Monday last, the crew of a curragh,* consisting of three men, met with a strange adventure northwest of Boffin Island. Having shot their spilletts (or long lines) in the morning, they observed to seaward a great floating mass, surrounded by gulls; they pulled out, believing it to be a wreck, but, to their great astonishment, found it to be a cuttle-fish of enormous proportions, and lying perfectly still, as if basking on the surface of the water. A knife was the only weapon on board. The cuttle is much prized as a bait for coarse fish, and the crew resolved to secure at least a portion of it. Considering the great size of the monster, and knowing the crushing and holding powers of the arms, open hostility could not be resorted to, and the fishermen shaped their tactics differently. Paddling up with caution, a single arm was suddenly seized and lopped off. The cuttle, hitherto at rest, became dangerously active now, and set out to sea at full speed in a

* A large kind of coracle made with wooden ribs, and covered with tarred canvas.

cloud of spray, rushing through the water at a tremendous rate. The canoe immediately gave chase, and was up again with the enemy after three-quarters of a mile. Hanging on the rear of the fish, a single arm was attacked in turn, while it took all the skill of the men to keep out of the deadly clutch of the suckers. The battle thus continued for two hours, and while direct conflict was avoided, the animal was gradually being deprived of its offensive weapons. Five miles out on the open Atlantic, in their frail canvas craft, the boatmen still slashed away, holding on boldly by the stranger, and steadily cutting down his powers. By this time the prize was partially subdued, and the curragh closed in fairly with the monster. Such as remained of the ten great arms slashed around through the air and water in most dangerous but unavailing fashion. The trunk of the fish lay alongside, fully as long as the canoe, while in its extremity, the mutilated animal emitted successive jets of fluid, which darkened the sea for fathoms around. The head at last was severed from the body, which was unmanageable from its great weight, and sank like lead to the bottom of the sea. Of the portions of the mollusk taken ashore, two of the great arms are intact, and measure 8 feet each in length, and 15 inches round the base. The two tentacles attain a length of 30 feet. The mandibles are about 4 inches across. The head, devoid of all appendages, weighed about 6 stone, and the eyes were about 15 inches in diameter.

It is evident, from the supine condition of this monster, that it was very sick or in a dying condition when attacked; otherwise, it would have escaped capture readily by diving. Certain exaggerations in the above account are probably due to the ignorance rather than invention of the captors.

In a further account of this animal,* Mr. A. G. More states that:

The tentacles were 30 feet long when fresh (14 and 17 feet can still be made up from the pickled pieces), and a short arm measured 8 feet in length, by 15 inches around the base. The club of the tentacle, nearly 3 feet in length, is occupied in the centre of the palm by two rows of large stalked suckers, nearly 1 inch in diameter, fourteen in each row; an alternating row of fourteen smaller suckers ($\frac{1}{2}$ in. diam.) occupies the margin on each side of the palm; these outer suckers had each a denticulated bony ring of about twenty-eight teeth, pointing inwards (the rings of the larger inner suckers had probably been removed or fallen out before the specimens were examined). Just beneath where the large suckers end, there is a cluster of very small ones arranged closely in six transverse rows, and the extremity of

* *Annals and Mag. of Nat. Hist.*, 4th ser., xvi, 123.

the club has also a great number of small suckers, whilst a few nearly sessile ones are scattered on the inner surface of the peduncle. Most of these had no denticulations on the rings. The beak has a wide, strong tooth about the middle of the edge of the upper mandible, and a much narrower notch on the outer mandible, on each side. These specimens are now in the Museum of the Royal Society, at Dublin.

Several very large cephalopods have been stranded on the coasts of Newfoundland and Labrador, within the past few years; most of them have been well described by Prof. A. E. Verrill.

STEENSTRUPIA, Kirk, 1882. Large, body comparatively slender, cylindrical, very slightly swollen in the middle; caudal fin small, rhomboidal, lateral; head long and narrow; eyes large, round; sessile arms small, all of same size; suckers stalked; internal shell lanceolate, with a hollow conical apex. *S. Stockii*, Kirk, New Zealand.

PLECTOTEUTHIS, Owen, 1881. Folded squid. Suckers upon a relatively broader flattened tract than in *Ommatostrephes*; back or dorsal side of the arms also with a broad tract, flanked by a thin fold of the integument extending the length of the arm on either side.

Described from a single gigantic arm preserved in the British Museum. The suckers are as in *Ommatostrephes*. The ventral arms of *Architeuthis* are similarly fringed, and it is very doubtful whether the characters given by Owen are sufficiently distinctive even for a subgenus. *P. grandis*, Owen (xxiv, 17).

MASTIGOTEUTHIS, Verrill. Body elongated, tapering to a point, confluent with the caudal fin posteriorly. Caudal fin very large and broad, rhomboidal, occupying about half the length of the body. Mantle fastened to the base of the siphon by an ovate, ear-shaped elevated cartilage on each side, fitting into corresponding deep, circumscribed pits on the base of the siphon. Siphon with a bilabiate aperture, an internal valve, and a pair of dorsal bridles. Eyes large, with round pupils; lids free, thin, apparently with a very small anterior sinus. Arms very unequal, the ventral ones much the longest. Suckers small, in two regular rows. Tentacular arms long and round, tapering to the tips, shaped like a whip-lash, without any distinct club; the distal portion is covered nearly all around with exceedingly numerous and minute suckers, which have only a very narrow, naked line along the outside. Pen narrow and bicostate anteriorly, very slender in the middle; posteriorly much larger, with a long tubular cone.

This remarkable squid is distinguished by the character of the tentacular arms and suckers, the pen, the connective cartilages, and simple eyelids. *M. Agassizii*, Verrill (xxiv, 15, 16).

MEGATEUTHIS, Hilgendorf, 1880.

Distr.—*M. Martensii*, Hilg. Japan.

Differs from *Ommatostrephes* in the greater length of the eight arms, which are longer than the mantle, in the thinness of the tentacular arms, and in the greater width of the pen, which is double that of *Ommatostrephes*, without rib and somewhat flabby.

Founded on portions of two individuals of a very large cephalopod. The length of one of them, including the outstretched tentacles, was about twenty feet, of which the head and body measured about seven and a half feet.

FAMILY SEPIIDÆ.

SEPIA, Linn., 1758.

Cuttle-fish. *Syn.*—*Palæoteuthis*, Rømer; *Sepiella*, Gray, 1849.

Distr.—Littoral, world-wide. *S. officinalis*, Linn. (xxvii, 48, 49), *S. elongata*, Orb. (xxvii, 50). 30 species. Fossil: 10 sp. Oxford Clay, Solenhofen; Miocene of Italy.

General characters those of the family (p. 13); under the eyes a lid-like fold, over them lachrymal openings; six aqueous pores in the buccal membrane; arms short; tentacles long; suckers long-pedunculated; siphon with very large valve. Fourth left arm hectocotylized to its base.

A few species are known only by the shell (cuttle-bone); which is a calcareous lamina lodged in the back of the body, very thick in front, concave internally behind; terminating in a prominent mucro. The thickened part is composed of numerous plates, separated by vertical fibres, which render it very light and porous. It was formerly used as an antacid by apothecaries.

The cuttle-fishes live near shore, and the mucro of their shell, d'Orbigny thinks, is intended to protect them in the frequent collisions to which they are exposed in swimming backwards.

According to Verany, this animal prefers rocky localities in the Mediterranean, where it is fished by means of a dredge called a *balancelle*, and is also taken at night with the trident. During the month of March the fishermen use a living female Cuttle fastened to a rope, or an imitation of one formed of wood, and made attractive to the male sex by being ornamented with bits of glass; this latter enveiglement is called by the Sicilians a *Fumedda*, and fishing with either of them is very productive and amusing, especially on a moonlight night. These animals may weigh several pounds; their flesh is much esteemed and abounds in the Italian markets at all seasons of the year. Out of the water the *Sepia* dies quickly, with violent efforts. At Rome the pigment *sepia* is still manufactured from the ink of this animal.

The chalky thickening of the shell is used as a dentifrice,* and also for modeling metallic objects, its surface receiving an exceedingly accurate impression. Cuttle-bone is a favorite beak-sharpener for caged birds.

The following observations on *Sepia officinalis* were made by Dr. Paul Fischer, in August, 1866, at the aquarium of Arcachon, Gironde, France. Besides the usual glass cases, there are here vast basins with earth bottoms, and of moderate depth, which receive the results of the fishery on the shore itself. Without this commodious arrangement, it would be impossible to preserve living, the very delicate animals.

The fishermen gather the young individuals called *Cassérons*, for food. When caught for the aquarium, they are at first placed in the great basins; they show themselves very timid, discharge inky clouds, and hide under floating objects; always shaded, they remain immobile in the horizontal position, nearly touching the earth by their ventral surface. After some days of repose, they are transferred to a glass aquarium.

The normal position of the *Sepia* is horizontal, the fins undulating gently, the sessile arms joined at their extremities, forming a sort of pyramid or tetrahedon. In this position the appearance of the head and arms is very like that of an elephant's head with the trunk. The tentacular arms remain contracted within the others when in repose; a position difficult to understand, as after death they are found to be more than double the length of the sessile arms. Sometimes the first pair of arms are raised into a vertical position, like antennæ, the others preserving their normal attitude; sometimes, also, the fourth pair of arms drop towards the earth for a few moments, and much elongate themselves.

The coloring of the *Sepia* is eminently variable; but if the day is clear, the dorsal surface and arms are magnificently striped; the edges of the fins are black, and their superior face is ornamented with spots of the same color. On the back of large individuals is seen two large obscure spots, which vary in intensity and sometimes entirely disappear. The eye is fatigued in following the incessant variation of coloring caused by the constant movement of the pigment cells, and the metallic reflections of the head and arms are glorious beyond human skill to reproduce. The skin is usually smooth; but when the animal becomes irritated, it shows granulations, principally on the head and back. This is accompanied by a retraction of the arms, which appear both shorter and narrower; the extremities no longer touch, but curve slightly. At the same time the colors change, a uniform gray tint takes the place of the striped bands. The approach of

* This manufacture is extensively pursued at Liverpool; as much as 12 cwt. of cuttle-bone arriving at one time for this purpose.

death is equally announced by a change of colors, which grow dull.

The swimming of the Sepia is differently effected, according to the speed required. A moderate progression is equally easy forwards or backwards. When the animal moves forward, the body remains horizontal; the tentacles, united and extended in front, rest on the fourth pair of arms. The Sepia follows in this manner the course of the water, the resistance of which bends the extremities of the united arms. A moderate backward movement is effected in the same manner; but the tentacles are more elongated and their extremities are somewhat parted; the arms are raised to the line of the body. The undulations of the fins commence at the front or rear, according to the direction which the animal takes. This method of swimming, due entirely to the fins, is not slow, for the normal movement of the Sepia is easy, elegant and rapid; but an occasion of disquietude, as the sight of an enemy, or a noise, causes a much accelerated, jerky and retrograde movement. To effect this the animal spreads its arms and suddenly reunites them; whilst the fins, reduced to inaction, are folded upon the ventral face of the body, the posterior extremity of one of them covering that of the other.

This accelerated action is then due to the movements of the arms, which cause a series of extremely rapid progressions, in which, perhaps, the funnel assists by its discharges. It is erroneous to regard the funnel, as some have done, as the principal or only swimming organ of the cephalopods.

The deposition of the eggs occurs some days after fecundation. I have been a witness to the deposition of three or four eggs, but I was not able to distinguish the method of the operation. A female laid about one hundred eggs, about fifty in a corner of the aquarium, and fifty on the opposite side. These eggs were enrolled by their peduncles around the long leaves of *Zostera marina* (xviii, 13, 14). The larger part of the eggs were laid in the night, for I remarked them in the morning for the first time; they were already black.

When the Sepia is laying, she embraces the leaf of *Zostera* with her tentacles, and a few instants afterwards the egg is attached. The female removed herself but little from her eggs, but she appeared to me to be sick, exhausted; she died three days after having commenced oviposition, and only a few hours after having attached her last eggs.

I found the ovary filled with a considerable quantity of eggs in all stages of development; the most advanced were already furnished with a white and opaque covering, but none of them were black like those attached to the *Zosteras*. The black color, then, is acquired at the moment of deposition, and it is probably due to a secretion of the glands which surround the oviduct.

The coloration of the eggs has not escaped the observation of Aristotle, but the explanation which he gives is more than doubtful. The very opaque and very dark skin of the excluded egg, later becomes thinner and nearly translucent. At the last period of development, if the skin is torn away and the viteline sack detached, one can introduce to the world, as I have often done, the young Sepia. It swims immediately, and changes color with the greatest facility.

The coloration of the Sepias several centimetres in length is more variable than that of the adults. The zebra-like black bands are not seen, but the general tint changes instantly from gray to wine-brown, to violet, to green. The young Sepias sink into the sand, only showing a part of the back and the head; they swim like the adults, but ascend and descend more frequently.

The eye of the Sepia has a very strange appearance; the dark pupil representing exactly a ω . It is furnished with an upper lid, colored by chromatophores, and a narrower, whitish under lid; there is also a very distinct palpebral sinus.

The sea-water destined for respiration enters the cephalic extremity of the branchial sack, and leaves by the siphon. The alternate movements of the openings of the sack and siphon can be readily seen.

The branchial sack in a number of adult Sepias was dilated from seventy to seventy-two times a minute, but in the young, about an inch long, the inspirations reached 140 in a minute. This result surprised me; it confirms, for animals of variable temperature, the law established for those of fixed temperature, that the number of inspirations is in inverse ratio to the age.

The use of the tentacular arms of the Sepias was absolutely unknown to me until I had the satisfaction to see them in motion on a morning of the month of August (1867). A case of the aquarium had contained for nearly a month a Sepia of medium size, which, during that time, had taken no nourishment. I threw to it a rather large-sized fish (Caranx), which swam towards the retreat of the Sepia—who had hardly perceived it, when, with prodigious celerity and precision, he unrolled and launched forward his tentacular arms, seized the fish and drew it towards his mouth. The tentacular arms then retracted and disappeared, but the sessile arms wrapped themselves closely around the head and anterior portion of the body of the unfortunate fish—which never made a movement after it was caught. The Sepia swam about easily in all directions for about an hour, eating the while; it then let the remains of the fish drop to the bottom of the aquarium, having opened the skull and devoured the brain as well as a portion of the muscles of the back.

The use of the tentacular arms is then no longer doubtful;

they serve for the seizure of food. I have been able to verify this fact a second time in examining the Calamaries—which pursued a troupe of little fishes, capturing them with these members. Moderate forward or backward progression is not due solely to the fins, but is assisted by the expulsion of water from the funnel; if the animal move forward, the funnel is recurved in front, and forms nearly a right-angle with the body; in retrograde movement the siphon becomes horizontal; it is placed to the right or left when the Sepia would turn, and is strongly recurved from front to back when it would mount to the surface of the water.

The variations of form of the siphon are indisputable, and one cannot doubt their influence upon the direction taken by the animal, but the marginal fins are not less useful; their undulations commencing anteriorly when the animal moves forward, and posteriorly in backward movement; they change suddenly as the direction may be varied. The same facts were remarked with regard to the Calamary.

SEPIELLA, Gray, 1849. Cuttle-bone weaker, subcartilaginous, always without either carina or posterior beak. At the posterior part of the bone is a profound subcutaneous pouch, opening by a large pore at the posterior extremity of the mantle between the fins.

HEMISEPIUS, Steenstrup, 1875.

Distr.—*H. typicus*, Steenst. (xxvii, 46, 47). Cape of Good Hope.

Differs from Sepia by the sessile arms having only two rows of suckers; the ventral surface of the mantle with aqueous pores situated in little nipples, and connected together by a longitudinal groove. The very rudimentary calcareous partitions of the inner side of the cuttle-bone only cover a portion of the excessively thin plate.

TRACHYTEUTHIS, Meyer, 1846.

Syn.—Cocoteuthis, Owen, 1855. Glyphiteuthis, Reuss?

Distr.—3 fossil species from the Jurassic of Europe. *T. hastiformis*, Ruppell (xxviii, 71).

Shell like Belosepia, thickened ventrally by horny, instead of chalky layers.

The shell resembles Sepia in the dorsal side being granulated, but the ventral side is horny instead of chalky; the posterior end has long wing-like expansions.

FAMILY BELOSEPIIDÆ.

BELOSEPIA, Voltz, 1830.

Distr.—5 fossil species. European Eocene. *B. sepioidea*, Blainv. (xxviii, 64, 65).

General characters those of the family. Doubtfully separable from *Sepia*.

The principal character of the shell or sepistaire, is the hood of chalky plates which covers the posterior end; these partitions are regularly placed and separated by cavities. The rostrum is thick, turned towards the back; the wing-like extensions of the shell are chalky.

FAMILY BELEMNITIDÆ.

The shell of Belemnites consist fundamentally of:—

1. A hollow cone, the *phragmocone* (ii, 19, 20), with a thin shelly wall, termed the *conothea*, and which is divided by transverse septa, concave above and convex below, into chambers or loculi; the chambers are perforated near the ventral margin by a *siphuncle*.

2. A *guard* or *rostrum* more or less extensively enveloping the apical part of the phragmocone. "The phragmocone is not a chambered body made to fit into a conical hollow previously formed in the rostrum, as some have conjectured, but both the rostrum and cone grew together; the former was formed on the exterior of a secretive surface, and the latter on the interior of another secretive surface."—PHILLIPS.

The rostrum is composed of calcareous matter arranged in fibres perpendicularly to the planes of the laminæ of growth. Professor Owen describes the fibres as of a trihedral prismatic form, and one two-thousandth of an inch in diameter. These fibres are disposed concentrically around an axis, the so-called apical line, which extends from the extremity of the phragmocone to that of the rostrum. Indications of a thin capsule or formative membrane appear in some Belemnites investing the guard; in those of the Oxford clay it is represented by a granular incrustation; in some liassic species it appears in delicate plaits, like ridges or furrows; in some specimens of *Belemnitella mucronata* from the upper chalk of Antrim, it is in the form of a very thin nacreous layer.

3. A *pro-ostracum*, or anterior shell, which is a dorsal extension of the *conothea* beyond the end where the guard disappears. The surface of the conothea is marked by lines of growth, and, according to Voltz, it may be described in four principal regions radiating from the apex; one dorsal, with loop lines of growth, advancing forward; two lateral, separated from the dorsal by a continuous straight or nearly straight line, and covered with very obliquely arched striae in a hyperbolic form, in part nearly parallel to the dorso-lateral boundary line, and in part reflexed, so as to form lines in retiring curves across the ventral portion nearly parallel to the edges of the septa. There were at least three kinds of pro-ostracum in the family Belemnitidæ.

A. In many Belemnites the extension of the *conothea* seems to run out in one simple broad plate, as in *B. hastatus*, from Solenhofen (ii, 22).

B. In *Belemnites Puzosianus*, d'Orbigny, the pro-ostracum is very thin, and apparently horny or imperfectly calcified in the dorsal region, supported laterally by two long, narrow, parallel, calcareous plates (*B. Puzosianus* from the Oxford clay, ii, 20). Professor Huxley considers this difference between the pro-ostraca of generic importance.

C. The third kind of pro-ostracum is exhibited by *Orthoceras elongata*, De la Beche, the type of the genus *Xiphoteuthis*, Huxley. It is calcareous, and is composed of concentric lamellæ, each of which consists of fibres disposed perpendicularly to the plane of the lamella; the phragmocone is very long and narrow, and the guard cylindroidal.

Professor Huxley suspects that a thoroughly well-preserved specimen of *Belemnoteuthis* will some day demonstrate the existence of a fourth kind of pro-ostracum among the Belemnitidæ.

"The *Acanthoteuthes* of Münster, so far as they are known only by hooks and impressions of soft parts, may have been either Belemnites, or *Belemnoteuthis*, or *Plesioteuthis*, or may have belonged to the genus *Celæno*."—HUXLEY.

The genus *Belopeltis*, Voltz, was founded on the pro-ostraca of Belemnites.

The genus *Actinocamax*, Miller, was founded on the guards of Belemnites and *Belemnitella*, the upper parts of which had decayed, and thus presented no alveolar cavity.—WOODWARD.

BELEMNITES, Lamarck.

Etym.—*Belemnion*, a dart.

Syn.—*Diploconus*, Zittel, 1868. *Actinocamax*, Voltz, 1840. *Gastrosiphites*, *Notosiphites* and *Pseudobelus*, Duval.

Distr.—100 sp., fossil only. *B. excentricus*, Keferst. (xxviii, 72).

Animal, arms and tentacles with two rows of horny hooks. Shell, phragmocone horny and slightly nacreous, with a minute globular initial chamber; two nacreous bands on its dorsal side, and produced beyond its rim into sword-shaped processes, represent the rostrum, which is fibrous, cylindrical, thickened behind, thin in front where it invests the phragmocone.

These animals, supposed to have been gregarious, from the number of their remains found in certain localities, were very numerous in species, over 100 having been described from the liassic and chalk formations of Europe, from the chalk of Southern India, from the Jurassic of the Himalayas, etc.

The phragmocone is very delicate, and its preservation is usually due to the infiltration of calcareous spar into its chambers. M. d'Orbigny supposes that the variation of the propor-

tions of the guard, as compared with the phragmocone, being sometimes only a half-inch longer than the latter, and sometimes one or two feet, depends partly on age and sex.

D'Orbigny has presented the following scheme of sections and subsections for dividing the large number of species of Belemnites; they have been generally adopted.

SECTION I. ACĒLI (Bronn.), guard without dorsal or ventral grooves.

Subsection 1. *Acuarii*, without lateral furrows, but often channeled at the extreme point. *B. acuaris*. 20 species. Lias—Neocomian.

Subsection 2. *Clavati*, with lateral furrows. *B. clavatus*. 3 species. Lias. (Includes the genera *Pachyteuthis*, *Megateuthis* and *Dactyloteuthis*, Bayle.)

SECTION II. GASTROCELI (d'Orb.), guard with ventral groove distinct.

Subsection 1. *Canaliculati*, no lateral furrows. *B. canaliculatus*. 5 species. Inferior oolite—Great oolite.

Subsection 2. *Hastati*, lateral furrows distinct. *B. hastatus*. 19 species. Upper lias—Gault. (Includes the genera *Cylindroteuthis*, *Belemnopsis* and *Hibolites*, Bayle.)

SECTION III. NOTOCELI (d'Orb.), guard with a dorsal groove, and furrowed on each side. *B. dilatatus*. 9 species. Neocomian. (Genus *Duvalia*, Bayle.)

HELICERUS, Dana, 1848.

Distr.—1 fossil species (*H. Fuegiensis*, Dana, xxix, 87), in slate rock, Cape Horn.

Shell like Belemnites, half-inch in diameter; guard thick, sub-cylindrical, fibrous; phragmocone slender, terminating in a fusiform spiral nucleus.

BELEMNITELLA, d'Orbigny, 1840.

Syn.—*Atractites*, Link, 1867.

Distr.—6 fossil species. Cretaceous; N. Am. and Europe. *B. mucronata*, Sowb. (xxviii, 70).

Rostrum with a straight fissure on the ventral side of its alveolar border; its surface with distinct vascular impressions. Casts of the alveolus show that the phragmocone was chambered, had a single dorsal ridge, and a ventral process entering the fissure of the rostrum.

XIPHOTEUTHIS, Huxley, 1864.

Distr.—*X. elongata*, Beche (xxviii, 68). Liassic, England.

Rostrum and pro-ostracum calcareous, phragmocone very long and narrow.

ACANTHOTEUTHIS, Wagner, 1839.

Etym.—*Acantha*, a spine, and *teuthis*, a calamary.

Syn.—Belemnosepia, Desh.; Belemnoteuthis, Pearce, 1842; Kalæno, Münster, 1836.

Distr.—17 fossil sp. Oolitic. *A. antiquus*, Cunn. (xxviii, 74).

Animal with ten nearly equal arms with two rows of horny hooks and suckers; margin of mantle free all around; fins large, medio-dorsal. Shell a phragmocone like Belemnites, a horny dorsal pen with obscure lateral bands and a thin fibrous rostrum with two diverging dorsal ridges.

CONOTEUTHIS, d'Orbigny, 1842.

Distr.—*C. Dupinianus*, Orb. (xxviii, 69). Neocomian, France.

Phragmocone slightly curved, chambered and siphunculated, with an elongated, slender pen. No protecting rostrum.

BELEMNOSIS, Edwards, 1849.

Distr.—*B. plicata*, Edwards (xxviii, 86). Eocene, London.

Phragmocone straight or slightly curved; rostrum rather long, thickened dorsally and obtuse at the hinder end, with a ventral opening.

BELOPTERA (Deshayes), Blainv., 1825.

Etym.—*Belos*, a dart, and *pteron*, a wing.

Syn.—Belopterina, Munier-Chalmas, 1872. Vasseurina, Munier-Chalmas, 1880. Bayanoteuthis, Munier-Chalmas, 1871.

Distr.—4 fossil species. Eocene of Paris and Bracklesham. *B. belemnitoides*, Blainv. (xxviii, 80).

Shell straight, rostrum sometimes winged on the sides, bluntly beaked at the hinder end.

SPIRULIROSTRA, d'Orbigny, 1841.

Dist.—*S. Bellardii*, d'Orb. (xxix, 81). Tertiary of Turin.

Phragmocone commencing with a spiral like Spirula, afterwards continuing straight; external spathose layer produced posteriorly into a long, pointed end.

FAMILY SPIRULIDÆ.

SPIRULA, Lamarek, 1799.

Syn.—Ammonia, Breyn., 1732.

Distr.—3 species, all tropical seas. *S. Peronii*, Lam. (xxvii, 51–53).

Body oblong, with minute terminal fins. Mantle supported by a cervical and two ventral ridges and grooves. Arms with six rows of very minute cups. Tentacles elongated. Funnel valved.

Shell placed vertically in the posterior part of the body, with the involute spire towards the ventral side.

Although thousands of shells of these mollusks are washed ashore in all parts of the world, the animal is almost unknown, but three perfect individuals, and several others, more or less imperfect, having been collected. The U. S. Coast Survey Steamer Blake, in 1878, dredged a *Spirula* with its mollusk, in the West Indies, at the great depth of 950 fathoms. Prof. Owen's last memoir on the *Spirula* adds materially to what was heretofore known respecting it. (*Ann. Mag. Nat. Hist.*, 5 ser., iii, 1, 1879.) He shows that the mantle terminates posteriorly in two lateral flaps which cover the sides of the shell, leaving it partly exposed dorsally and ventrally. Posteriorly, between the lobes, is an elliptical, convex body, with a central depression or disk, flanked by a pair of oblong productions, perhaps homologous with fins, or at any rate resembling the small lateral-terminal fins of *Loligopsis*. The terminal disk is, perhaps (as long ago described by Rumphius), a true sucker, enabling the animal to attach the posterior end of its body to any object, leaving the arms free to exercise their prehensile power on passing objects of food. This wonderful terminal sucking organ is not found in any other cephalopods, but may have been possessed by the animal of Ammonites, supposing it to have been related to the *Spirula* rather than the Nautilus. The anatomy of *Spirula*, which is carefully worked out and illustrated in Prof. Owen's memoir, shows it to belong to the dibranchiate decapod cuttle-fishes, as already indicated by previous studies. Whilst *Spirula* possesses natatory powers superior to the Nautilus, in the action of its webbed arms, additional to that of the funnel, the former are so small in proportion to the size of the animal, and the fins are so rudimentary as to indicate sedentary habits. Prof. Owen observes that in *Spirula*, as in Nautilus, "the shell serves as the *point d'appui* of the retractors of the funnel and of the head with its locomotive and prehensile organs. Moreover, the last chamber of the shell in *Spirula* also receives part of the visceral mass, viz., the hind termination of the liver, which, covered by its capsule, and this again by the peritoneum or a delicate aponeurosis continued from the attached shell-muscles, constitutes the hemispheric mass that fills the chamber and forms or sends off the beginning of the membranous siphon."

In another memoir, Prof. Owen shows that the dorsal portion of the animal of *Spirula* is placed towards the outer wall of the shell, which is the reverse of the relative positions of animal and shell in both Nautilus and Ammonites, showing that the spiral growth of the shell cone took a contrary direction. He agrees that the aptychi are developed on the spadix of Ammonites, and are true opercular bodies; consequently the Ammonite could

not have been like the *Spirula*, an internal shell, but must have been closely related to *Nautilus*.*

According to some recent investigators, there is a marked resemblance between the recent *Spirula* and the fossil *Ammonites*, particularly in the initial whorl, and a difference in the latter character between *Ammonites* and *Nautilus* which is thought to indicate that the *Ammonites* should be separated from the tetrabranchiate and united with the dibranchiate cephalopods. If this should prove to be so, then the *Spirula* will assume a new importance to us as the last vestige of a numerous group, else extinct.

In *Proc. Zool. Soc.*, London, 1880, Prof. Owen describes and figures a male *Spirula*. The ventral pair of arms are modified for the sexual purpose, but are not hectocotylized, having lost all trace of acetabular organization.

ORDER II. TETRABRANCHIATA.

FAMILY NAUTILIDÆ.

Septa simply curved, concave on the outer face, sutures simple, or undulate or lobed; mouth simple; siphonal opening nearly central. Shell but little sculptured, or smooth.

Six living and over 2000 fossil species.

FAMILY AMMONITIDÆ.

Septa convex in their median section, sutures complex, lobed, ramified or denticulated; septal tube cylindrical and always directed forwards; siphuncle cylindroid, small, marginal, the siphonal investment more or less solid and persistent. Fossil only, several thousand species known.

Nearly 5000 fossil species of cephalopod shells have been referred to the tetrabranchiates, although it has been recently suspected that at least a large portion of these were internal shells like the *Spirulas* and referable therefore to the dibranchiata. Only a half-dozen recent species are known, all belonging to the genus *Nautilus*.

The tetrabranchiate shell is essentially an elongated cone, divided off into chambers by partitions, and siphunculated. These septa have simply curved edges in *Nautilus* and *Orthoceras*, they are zigzag in *Goniatites*, or foliaceous, forming complicated lobes in *Ammonites*. The shell may be straight, curved, open or close spiral, and even vary in form at different ages, and these variations, when well understood, will doubtless cause a

* Owen, on the Relative Positions to their Constructors of the Chambered Shells of Cephalopods. *Zool. Proc.*, 955, 1878.

large reduction to be made in the number of generic forms at present accepted. The following synopsis will exhibit these variations in some of the more important genera.

FORM OF SHELL.	NAUTILIDÆ.	AMMONITIDÆ.		
		With undulating sutures.	Sutures toothed at the base.	Sutures complex lobed or foliaceous.
Straight	Orthoceras.....	.....	Baculina.	Baculites.
	Bactrites.....	.....	.....	Rhabdoceras
	Gomphoceras.....	.....	.....	.....
Bent or curved.....	Cyrtoceras.....	.....	.....	Toxoceras.
	Phragmoceras.....	.....	.....	.....
Discoidal spire and { free whorls..... }	Ascoceras.....	.....	.....	.....
	Gyroceras.....	.....	.....	Cryoceras.
<i>Ibid.</i> Finally straight or hook-shaped.	Lituities.....	.....	.....	Ancyloceras.
Hook-shaped or bent upon itself more than once, whorls free. ....	.....	.....	.....	Hamites.
<i>Ibid.</i> Straight portions in contact. ....	.....	.....	.....	Ptychoceras.
Involute, spiral.	Nautilus.....	Goniatites..	Ceratites.	Ammonites.
	Nothoceras.....	.....	.....	.....
	.....	Clymenia..	.....	Clydonites.
Involute; last chamber detached, hook-shaped .....	.....	.....	.....	Scaphites.
Elongated, spiral, whorls in contact. ....	.....	.....	.....	Turrillites.
	.....	.....	.....	Cochloceras.
Spiral, elongated, whorls not in contact	Trochoceras ..	.....	.....	Helicoceras.
Spiral, elongated, the last whorl free, produced and recurved.		.....	.....	Heteroceras.

FAMILY NAUTILIDÆ.

ORTHOCERAS, Breynius, 1732.

Etym.—*Orthos*, straight, and *ceras*, a horn.

Syn.—*Actinoceras*, Bronn, 1835. *Orthoceratites*, Breyn. *Jovellania*, Bayle, 1878. *Cycloceras* and *Loxoceras*, M'Coy, 1844.

Distr.—Fossil, 1200 sp. L. Silurian to Triassic; N. America, Australia, Europe. *O. subannulare*, Barr. (xxix, 79). *O. planicanaliculatum*, Sandb. (xxviii, 67).

Shell straight, aperture sometimes contracted.

Probably the animal was not able to withdraw itself completely

into its shell, as in the *Nautilus*. That the shell was external is indicated by the colored bands preserved on *O. anguliferus*. These shells sometimes grew to a great size; a specimen in the collection of Mr. Tate of Alnwick, England, must have been six feet long when perfect. Newberry, in the Palæontology of Ohio, estimates another species, *O. Titan*, to have weighed "some tons." The aperture is sometimes so contracted that species two feet in length have a diameter of only one inch at the mouth.

CAMEROCERAS, Conrad, 1842. (*Melia*, Fischer; *Sannionites*, Fischer.) Siphuncle lateral, sometimes very large (simple?). Casts of the large siphuncles were called *Hyalites* by Eichwald. *Distr.*—27 sp. L. Silurian to Triassic(?); N. America, Europe.

ACTINOCERAS (Brown), Stokes. Siphuncle very large, inflated between the chambers and connected with a slender central tube by radiating plates. 6 sp. L. Silur. to Carb.; N. America, Europe. *O. Richardsoni*, Stokes (xxix, 78).

ORMOCERAS, Stokes, 1838. Siphuncular beads constricted in the middle, so that the septa appear as if united to the centre of each. Probably identical with *Actinoceras*. *Distr.*—3 sp. L. Silurian to Devonian; N. America. *O. Bayfieldi*, Stokes (xxix, 84).

HURONIA, Stokes, 1823. (*Discosurus*, Hall, 1852.) Shell extremely thin, membranous or horny(?). Siphuncle very large, central, upper portion of each joint inflated, connected with a small central tube of radiating plates. Usually the siphuncle only is preserved. Dr. Bigsby observed specimens six feet in length. Doubtfully distinct from *Actinoceras*. *Distr.*—3 sp. L. Silurian; Drummond Isl., Lake Huron. *H. vertebralis*, Stokes (xxix, 85).

AULACOCERAS, Hauer. Shell much thickened, longitudinally furrowed, with two deep lateral sulcations; siphon very small, marginal. *Distr.*—4 sp. Upper Triassic; Austria.

BATHMOCERAS, Barrande, 1865. Part of the body-chamber occupied by imbricating plates, decreasing in horizontal extension from below upwards; siphuncle a series of superimposed funnel-shaped tubes. *Distr.*—4 sp. Silurian; Bohemia, Sweden, Lake Huron.

ENDOCERAS, Hall, 1847. (*Conotubularia*, Troost; *Diploceras*, Conr.) Shell extremely elongated, cylindrical. Siphuncle very large, cylindrical, lateral; thickened internally by repeated layers of shell, or partitioned off by funnel-shaped diaphragms. *Distr.*—12 sp. L. Silurian; New York, Europe.

TRETOCERAS, Salter, 1858. (*Diploceras*, Salter, not Conrad, 1856; *Nothoceras*, Eichw., 1859.) Founded on *O. bisiphonatum*, Sowb. (xxx, 93), from the Caradoc sandstone (Silurian), Brit., in which the septa are apparently perforated by two siphuncles; one of which is a deep lateral cavity continuous with the terminal

chamber—the cavity affecting at least seven of the uppermost septa, if not the whole.

THISOA, Montf. Shell ovate-elongate, cucumber-shaped; apparently two siphons running parallel the whole length of the shell, one of which traverses a sort of narrow lateral cavity; there are also a number of false siphons or holes, which do not extend the entire length of the shell. *T. siphonalis*, Serres (xxix, 82, 83). Jurassic; France.

GONTOCERAS, Hall, 1847. Shell flattened, with extremely salient angles; septa sinuous; section of shell, an extended ellipse with projecting angles; siphuncle ventral. *G. anceps*, Hall (xxx, 94, 95). L. Silurian; N. America.

COLPOCERAS, Hall. This is probably only a siphon of one of the larger species of Orthocerata. *C. virgatum*, Hall (xxx, 96). L. Silurian; New York.

DICTYOCERAS, Eichw., 1859. Is probably an Orthoceras covered by a bryozoan or coral.

TREMATOCERAS, Whitfield. Tube, septa and siphuncle like Orthoceras, but with a line of elongated, raised tubercles along one side of the shell, which have formed perforations at certain stages of growth, probably confined to the outer chamber as openings, which were closed as the animal extended the shell, and before the septa opposite them were formed. Type *T. Ohioense*, Whitfield. Upper Helderberg group, Ohio.

[**POLORTHUS**, Gabb, 1861.

The aggregated mass of specimens forming the type of this genus was originally referred to *Teredo*; subsequently, in describing the genus, Mr. Gabb referred it to *Vermetidæ*, and in 1872 he finally believed it to be a cephalopod connecting the Orthoceratidæ with *Beatriceæ*. The aggregate character, the long, narrow, irregular tube, the non-molluscan character of the partitions forbid this determination. I am convinced that *Polorthus* is not a mollusk, and *Beatricea* itself is now referred, doubtfully, to the sponges.]

CLINOCERAS, Maseke, 1876.

Distr.—*C. dens*, Maseke (xxviii, 73). Erratic L. Silurian blocks; Prussia.

Shell conical (allied to *Loxoceras*, McCoy), the siphuncle side straight, the others more or less curved; a constriction below the body-chamber. Septal border with an obtuse-angled saddle on the siphuncle side, with gently rounded lobes and two slightly marked lateral saddles.

BACTRITES, Sandberger, 1842.

Syn.—*Stenoceras*, d'Orb, 1850.

Distr.—13 sp. Silurian to Trias.: Germany, etc. *B. gracilis*, Sandb. (xxxii, 22). Nassau.

Shell straight, conical; a small sutural lobe corresponds to the marginal siphon.

PILOCERAS, Salter, 1859.

Etym.—*Pilos*, a cap, and *ceras*, a horn.

Distr.—Fossil, 3 species. L. Silurian; Canada, Scotland (Ideal section, xxx, 97).

Shell broad, conical, subcylindrical or compressed, slightly curved. The siphuncle and septa represented by a series of conical septa, concave to a central point. Closely related to *Cyrtoceras*.

CYRTOCERAS, Goldfuss, 1832.

Etym.—*Curtos*, curved, *ceras*, a horn.

Syn.—*Aploceras*, d'Orb., 1850. *Campulites*, Desh. (part), 1832. *Campyloceras* and *Trigonoceras*, M'Coy, 1844.

Distr.—Fossil, 350 species. L. Silurian to Carb.; N. and S. America, Europe. *C. acuticostatum*, Sandb. (xxx, 98).

Shell curved; siphuncle small, subcentral.

Seems to differ but little from *Orthoceras*.

ONCOCERAS, Hall, 1847. (*Oncos*, a protuberance, *ceras*, a horn.) Anterior half of the shell inflated, aperture more or less strangulated. This may possibly = *Phragmoceras*, Brod. *Distr.*—3 sp. Silurian; New York. *O. constrictum*, Hall (xxx, 997).

CYRTOCERINA, Billings, 1865. Shell short and thick, with a large siphuncle, placed externally. *Distr.*—2 species. Silurian; Canada.

STREPTOCERAS, Billings, 1865. Shell like *Oncoceras*, but the aperture trilobed. 2 species. Middle Silurian; Canada.

GOMPHOCERAS, J. Sowb., 1839.

Etym.—*Gomphos*, a club, and *ceras*, a horn.

Syn.—*Apioceras*, Fischer, 1844. *Poterioceras*, M'Coy, 1844. *Mesoceras*, Barrande, 1877. *Bolboceras*, Fischer, 1844. *Neliemenia*, Casteln., 1843.

Distr.—100 sp. L. Silurian to Carb.; Europe, N. America. *G. pyriforme*, Murchison (xxx, 100). Silurian; England. *G. Bohemicum*, Barr. (xxx, 1). Aperture.

Shell fusiform or bottle-shaped, straight, swollen anteriorly; aperture contracted in the middle; siphuncle subcentral; septa simple, concave.

SYCOCERAS, Pictet, 1854.

Distr.—Silurian, Devonian. *S. orthogaster*, Sandb. (xxx, 21).

Shell oval or bottle-shaped, straight; septa simple; siphuncle marginal.

The position of the siphon varies so much in this group, that it is an insufficient character to distinguish the genus from *Gomphoceras*.

ASCOCERAS, Barr., 1847.

Etym.—*Ascos*, a leather bottle, *ceras*, a horn.

Syn.—*Cryptoceras*, Barr., 1846.

Distr.—16 sp. L. and U. Silurian; Europe, Canada. *A. Bohemicum*, Barr. (xxx, 3).

Shell flask-shaped; the terminal chamber not only fills the front of the shell, but extends down the dorsal side, nearly its whole length, as a deep cavity, which is embraced by the decurrent edges of the four or five incomplete septa; a minute siphuncle on the ventral side.

GLOSSOCERAS, Barr., 1865.

Etym.—*Glossa*, a tongue, *ceras*, a horn.

Distr.—2 sp. M. and U. Silurian; Anticosti; Bohemia.

Shell like *Ascoceras*, but the ventral margin of the aperture ligulately extended and incurved.

APHRAGMITES, Barr., 1865.

Etym.—*A*, without, *phragmos*, a partition.

Distr.—2 sp. U. Silurian; Bohemia.

Shell like *Ascoceras*, but the septa are deciduous.

PHRAGMOCERAS, Brod., 1839.

Etym.—*Phragmos*, a partition, and *ceras*, a horn.

Syn.—*Campulites*, Desh. (part), 1832; *Phragmolites*, Conr., 1838.

Distr.—50 sp. Silurian to Devonian; Europe, N. America. *Ph. ventricosum*, Murch. (xxx, 4). Silurian; England. *Ph. callistoma*, Barr. (xxxi, 6). Aperture.

Shell compressed on the sides, curved; aperture contracted in the middle; last chamber large; siphuncle dorsal, with radiations; septa simple.

GYROCERAS, de Koninck, 1844.

Syn.—*Nautiloceras*, d'Orb, 1847. *Polyconites*, Troost (?), 1840.

Distr.—40 sp. Silurian to Triassic (?); Europe, N. America. *G. Goldfussii*, Arch. (xxxi, 7). Devonian; Eifel.

Shell planorboid, with separated whorls; septa simple, but little curved; siphuncle excentric, with radiations; last chamber large; mouth but little contracted.

NOTHOCERAS, Barr., 1856.

Distr.—*N. Bohemicum*, Barr. (xxx, 5; xxxi, 8). U. Silurian; Bohemia.

Shell nautiloid, slightly involute; septa but little curved, not lobed.

HERCOCERAS, Barr., 1865.

Etym.—*Erkos*, a wall, *ceras*, a horn.

Distr.—2 sp. Middle Silurian, Bohemia; Devonian, Nassau (?).

Shell generally nautiloid, the whorls sometimes separated, or even turbinate; body-chamber with a diaphragm perpendicular to the axis of the shell, the concavity of which is opposed to that of the last septum, throwing the aperture on the deeply excavated dorsal side of the shell; siphuncle ventral, cylindrical, inflated between the chambers, separated from the shell.

LITUITES, Breyn., 1732.

Etym.—*Lituus*, a trumpet.

Syn.—*Trocholites*, Emmons, 1842. *Palæonautilus* and *Palæoclymenia*, Remelé.

Distr.—28 sp. Silurian; Europe, North America. *L. simplex*, Barr. (xxxi, 9).

Shell planorbiform, the whorls close or separate; the last chamber produced in a straight or outwardly curved line; lateral margins of the aperture extended and curved towards the interior of the shell, contracting the aperture into two distinct orifices.

OPHIDIOCERAS, Barrande, 1867. *Etym.*—*Ophiodes*, serpent-shaped, *ceras*, a horn. Shell with the produced portion very short or wanting. *Distr.*—7 sp. Silurian; Norway, Bohemia.

STROMBOLITUITES, Remelé, 1881. Shell commencing as a small spiral, expanding into an obconic form. L. Silurian; Germany. *S. Torelli*, Remelé (xxix, 90).

HORTOLUS, Montf., 1808. Whorls not in contact.

DISCOCERAS, Barrande, 1867.

Etym.—*Diskos*, a quoit, *ceras*, a horn.

Distr.—3 sp. Middle Silurian; Russia, Germany, Norway.

Shell planorbiform; produced portion very short or wanting; aperture simple, not contracted.

M. Barrande describes this as a subgenus under his genus *Lituunculus*; of which no species have been observed, but which he creates by anticipation with the diagnosis: "Shell like *Lituities*, but with a simple aperture," in order that *Discoceras* may hold the same relationship to it that *Ophidioceras* does to *Lituities*! This is filling up the "gaps" with a vengeance, and could scarcely have been predicted of the renowned Bohemian anti-developmentalists.

PTERONAUTILUS, Meek, 1867.

Etym.—*Pteron*, a wing, and *Nautilus*.

Distr.—*P. Seebachianus*, Geinitz (xxxi, 10). Permian.

Shell spiral, involute, finally produced, with lateral wing-like expansions.

SUBCLYMENIA, d'Orb, 1850.

Distr.—*S. evoluta*, d'Orb (xxx, 12, 13). Devonian; England. Shell spiral, planorbiform; sutures of septa sinuous, not angular on the sides, but with a single dorsal lobe.

TROCOCERAS, Barr., 1847.

Distr.—60 sp. L. Silurian to Devonian; Bohemia, France, North America.

Shell depressed, spiral, nautiloid or nearly discoidal; whorls free; septa simple. Very closely related to *Lituities*.

NAUTILUS, Breyn., 1732.

Syn.—*Angulites*, Montf., 1810; *Omphalia*, De Haan.

Distr.—6 living species, tropical seas; and nearly 300 fossil species, commencing with the Silurian. *N. Pompilius*, Linn. (iv, 62, 63; xxvii, 54).

Shell involute or discoidal, few-whorled; septa concave, simple; siphuncle nearly central.

Outer surface smooth in the recent species, but corrugated in some of the fossil ones.

Animal placed with its ventral face to the convex (dorsal) wall of the shell.

They are divided into the following groups:

1. *Lævigati*. Shell smooth. Permian—Living.
2. *Radiati*. Shell transversely ribbed. Principally cretaceous.
3. *Striati*. Shell longitudinally striate. Oolite of Europe, and Lower Chalk, India.

Respecting the habits of the *Nautilus* very little is known: the specimen dissected by Prof. Owen had its crop filled with fragments of a small crab. Rumphius states that "when the *Nautilus* floats on the water, he puts out his head and all his tentacles, and spreads them upon the water, with the poop of the shell above the surface; but at the bottom, he creeps in the reverse position, with his boat above him, and with his head and tentacles upon the ground, making a tolerably quick progress. He keeps himself chiefly upon the ground, creeping also sometimes into the nets of the fishermen; but after a storm, as the weather becomes calm, they are seen in troops, floating on the water, being driven up by the agitation of the waves. This sailing, however, is not of long continuance; for having taken in all their tentacles, they upset their boat, and so return to the bottom."

The shell is composed of two layers—the outer one porcellaneous, the inner pearly; and the Chinese avail themselves of this circumstance to produce elegant relieved carvings upon the pearly layer. Specimens are frequently imported for sale.

During the voyage of the *Challenger*, a living *N. Pompilius* was dredged in three hundred and twenty fathoms, off Matuka

Island, Fiji group. It was very lively, swimming around in a tub, in a retrograde direction, by the ejection of water from the funnel. The tentacles were extended radially from the head, somewhat like those of a sea anemone; but each pair had its definite and different direction, which was constantly maintained; thus one pair of tentacles was held pointing directly downwards, two other pairs, situate just before and behind the eyes, were held projecting obliquely outwards and forwards, and backwards respectively, as if to protect the organs of sight.

The natives of the New Hebrides, New Caledonia, and the Fiji group of islands, capture the Nautilus, and use it as an article of food. They take them in their fish-falls, in from three to five fathoms of water; the bait they use is the echinus. They are very fond of them. In some of the islands they make a kind of soup of them. At the Island of Ware, about 30 miles from New Caledonia, they are roasted, and taste like whelks (*Buccinum*).

The Fijians esteem the Pearly Nautilus highly as an agreeable viand, and their mode of capturing it for the embers or the pot is not a little interesting. When the water is smooth, so that the bottom at several fathoms of depth, near the border of the reef, may be distinctly seen, the fisherman in his little frail canoe scrutinizes the sands and the coral masses below, to discover the animal in its favorite haunts. The experienced eye of the native may probably encounter it in its usual position, clinging to some prominent ledge, with the shell turned downwards. The tackle consists, first, of a large round wicker-work basket, shaped very much like a cage rat-trap, having an opening above, with a circle of points directed inwards, so as to permit of entry, but preclude escape; secondly, a rough piece of native rope, of sufficient length to reach the bottom; and thirdly, a small piece of branched wood, with the branches sharpened to form a sort of grapnel, to which a perforated stone is attached, answering the purpose of a sinker. The basket is now weighted with stones, well-baited with boiled cray-fish, and then dropped gently down near the victim. The trap is now either closely watched, or a mark is placed upon the spot, and the fisherman pursues his avocation upon other parts of the reef, until a certain period has elapsed, when he returns, and in all probability finds the Nautilus in his cage feeding upon the bait. The grapnel is now carefully let down, and having entered the basket through the opening on top, a dexterous movement of the hand fixes one or more of the points or hooks, and the prize is safely hoisted into the canoe.

The Pearly Nautilus is not found at the Navigator group of islands in the South Seas, and the shells form there an important article of exchange. They are brought by European vessels from New Caledonia and the Fiji Islands as articles of trade, and are

bartered with the natives at the rate of four for a dollar or one shilling each. I am told it is indifferent to the natives if the shells are old or rather damaged, as they use the chambered portions for ornament, rubbing them down to suit the various purposes to which they apply them. They also make armlets and other ornaments from the shell. A vessel arrived at Sydney from New Caledonia with several tons of these shells, which were disposed of as an article of trade to the Navigator and Friendly Islands; they were sold at Sydney at about $1\frac{1}{2}d.$ each.

I have seen a very elegant fillet formed of these shells (of very small size), brought from the Samoan Islands, the brilliancy of which was that of the most highly burnished silver. They are used by the natives in war, and are highly valued; this one costing twenty dollars. The shells are fixed to a small midrib of cocoanut leaf, which supports them on a worked band of sinnet; upon this, under the row of seventeen shells, small pieces of the same pearly shell were placed to add to the ornamental effect. The length of the band was 12 inches (not including the tying strings) and the depth 3 inches.—DR. GEORGE BENNETT, *Proc. Zool. Soc.*, 226, 1859.

In India elegant drinking cups are made of *Nautilus Pompilius*, the exterior coating being relieved by carving on the inner pearly lamina; or it is sometimes grotesquely painted. Cameo carving on the shell of the Nautilus is extensively practiced in England and other countries, and shells thus prepared are highly valued as ornaments.

ATURIA, Bronn, 1838. (*Megasiphonia*, d'Orb., 1847.) Sutures of septa with a deep lateral lobe; siphuncle on the concave or inner side of the shell, large, continuous, like a succession of funnels. *Distr.*—6 sp. Eocene, Miocene; N. America, Europe, India. *A ziczac*, Sowb. (xxxi, 14, 16).

DISCITES, M'Coy, 1825. Whorls all exposed; last chamber sometimes produced. *Distr.*—5 sp. L. Silurian, Carb.

TEMNOCHEILUS, M'Coy, 1844. (*Endolobus*, Meek and Worthen, 1866.) Shell carinated, with an open, conical umbilicus. *Distr.*—5 sp. Carb. limestone *N. biangulatus*, Sowb. (xxxi, 15).

TREMATODISCUS, Meek and Worthen, 1861. Like *Temnocheilus*, but outer side of whorls with revolving angles and sulci, and frequently, revolving striæ. *Distr.*—Carboniferous; Europe, America. *N. trisulcatus*, Meek and Worthen (xxxi, 17, 18). Subcarboniferous; Rockford, Ind.

CIMOMIA, Conrad, 1866. Septa sinuous, double waved or sigmoid, numerous; siphon small, central. *N. Burtoni*, Galeotti. Lower Eocene.

HERCOGLOSSA, Conrad, 1866. (*Aganides*, Montf.?) Septa angular and linguiform; apex of the angle or tongue-shaped lobe not contiguous with the adjacent septum; siphon large or moderate,

situated within the centre, or between the middle and the inner margin, and not funnel-shaped, but tubular and gradually tapering. *Distr.*—Eocene, Cret.; Europe, America.

A very doubtful group, as Conrad includes species having respectively the characters of *Aturia* and of *Nautilus*; the type species is *N. orbiculatus*, Tuomey.

PSEUDONAUTILUS, Meek, 1876. Differs from *Hercoglossa* in the septa being provided with well-defined peripheral and anti-peripheral lobes and the siphuncle placed near the outer margin. *Nautilus Geinitzi*, Oppel.

CRYPTOCERAS, d'Orb., 1847. (*Solenochilus*, Meek and Worthen, 1877.) Planorbiform; septa arcuated, without lobes or sinuosities; siphon dorsal. *Distr.*—2 sp. Devonian, Carboniferous; Europe. *C. subtuberculatus*, d'Orb. (xxx, 504).

BEAKS OF TETRABRANCHIATES.

These are found associated with fossil Nautili and occasionally Belemnites, but never with Ammonites. The upper beaks have been described under the name of *Rhyncholites*, the lower ones as *Conchorhynchus*.

R. Astieriana, d'Orb. (xxxv, 74).

C. avirostris, Bronn (xxxv, 75).

C. Owenii, Bronn (xxxv, 76).

PELTARION, Deslongchamps. This was formerly believed to be the mandibular armature of tetrabranchiates, consisting of circular or transversely-oval calcareous plates, with rounded anterior and produced and truncated posterior margins. Through the researches of M. Crosse (*Jour. de Conch.*, 3 ser., xv, 57, 1875), there is no doubt that these *Peltariæ* are opercula of fossil species of *Neritopsis*; they resemble the operculum of the recent *N. radula*.

Several species have been described from U. Lias to Coral-line Rag. *P. bilobatum*, Desl. Upper Lias of Normandy.

FAMILY AMMONITIDÆ.

Animal contained in the last division of a chambered shell; protected by one or two operculigerous plates (*Aptychi*); without ink-bag.

Shell external, of variable form, composed of two principal layers, the inner one of which is nacreous; sutural line of the septa more or less complicated or lobed; siphon simple, without organic layer.

Initial chamber ovoid, smooth, without exterior cicatrice, containing a siphonal cæcum free from the inner wall. Embryonic shell generally showing an umbilicus at each extremity of its axis; first chamber convex in front.

The above are the characters given to the order *Ammonea* by

Fischer, who places it between the Dibranchiata and Tetrabranchiata. The principal character which the Ammonitidæ possess in common with the former is the early development of the shell, the initial chamber being without cicatrice; but, on the other hand, the possession of an external shell is abundantly indicated by its exterior ornamentation, by its opercular plates and by other characters. I prefer to consider them tetrabranchiates—an opinion powerfully supported by Prof. Richard Owen, so lately as 1878.

The Ammonitidæ became essentially extinct towards the close of the secondary period, although a few forms are now referred to the tertiary. The geological position of the genera may be thus indicated:

Arcestes, Didymites, Lobites, Pinacoceras, Ptychites, Trachyceras, Tropites are exclusively Triassic.

Arietites, Harpoceras, Ekotraustes, Oppelia, Peltoceras, Stephanoceras, Simoceras, etc., are Jurassic.

Acanthoceras, Olcostephanus, Schlœnbachia, Stoliczkaia, etc., are Cretaceous.

Sageceras is Permian and Triassic. Ægoceras is Triassic and Liassic. Amaltheus, Lytoceras, Phylloceras, occur in Triassic, Jurassic and Cretaceous beds. Aspidoceras, Cosmoceras, Haploceras and Perisphinctes are found in the Jurassic and Cretaceous.

The aptychi or so-called opercula of Ammonites (ii, 33) are constantly found associated with (and generally within the aperture of) the shells of some of the groups. They are horny or shelly plates, and have been generally supposed to be opercula; if so, they were probably secreted by the disk or hood, which, formed by the coalescence of the two dorsal arms, closes the aperture of the recent Nautilus, and corresponds to the velamentous arms of the Argonaut. If the Ammonites were dibranchiates allied to Spirula—that is having internal shells—they could not have possessed opercula.

Prof. Waagen has adopted the theory first suggested by Keferstein and advocated by Zittel, that the aptychi were connected with the nidamental gland; and he has grouped the family according to the presence, absence or peculiarities of these bodies as follows:

- A. Nidamental gland without solid integument or Aptychus:
 - Phylloceras, Lytoceras, Arcestes, Pinnoceras, Trachyceras.
- B. Nidamental gland with an Aptychus.
 1. Gland simple, not divided.
 - Aptychus horny: Arietes, Ægoceras, Amaltheus.
 - Aptychus calcareous: *A. numida*, Coq. (shell unknown).

2. Gland double, aptychus calcareous.

Aptychus furrowed externally: Harpoceras, Œkotreustes, Oppelia, Haploceras, Scaphites?

Aptychus thin, granulated externally: Stephanoceras, Perisphinctes, Peltoceras, Cosmoceras.

Aptychus thick, smooth and punctate externally: Simoceras, Aspidoceras.

In the absence of positive knowledge as to the true relations of the Aptychi with the shells of Ammonites, and until much more extensive observations shall have been made, the groupings indicated above must be regarded as simply provisional.

One of the latest authorities on the subject (Prof. Owen, *Zool. Proc.*, 955, 1878), regards the aptychi as true opercula.

The following "genera" of Aptychi have been characterized:

TRIGONELLITES, Parkinson. Shelly, divided into two plates by a straight median suture; external surface smooth or sculptured, inner surface marked by growth-lines.

Associated with the round-backed Ammonites, and a single specimen with Goniatites. Nearly fifty varieties have been described.

Meyer considered them bivalve shells, and described them under the name of Aptychus; Deslongchamps, with the same impression, called them Munsteria; d'Orbigny thought them plates of cirripeds, and Deshayes believed them to be the gizzards of Ammonites; Coquand compared them with Teudopsis, and they certainly resemble in some degree that genus, as well as Beloteuthis, Belemnosepia, etc.

ANAPTYCHUS, Oppel. Horny and flexible, in a single piece. Associated with the Arietes group of Ammonites.

The classification of the Ammonitidæ, and particularly of the genera dismembered from the old genus Ammonites, is involved in much confusion, partly in consequence of the selection by several systematists of different generic characters as of primary importance throughout the group, partly owing to the instability of some of the most obvious characters. Surface ornamentation and even form are now known to change with age; and on this account the following scheme of classification of the genus Ammonites, elaborated by von Buch and d'Orbigny, is no longer available for the discrimination of the several thousand described species. As examples of the extent to which naturalists have been misled by these mutable characters, it may be mentioned that *A. splendens*, from the greensand of Cambridge, England, according to Mr. Seeley, includes fourteen other so-called species from the same bed.

A. Dorsal portion of whorls rounded, not keeled.

1. Fimbriati. Oolitic. *A. fimbriatus*, d'Orb. (xxxiii, 45, 46).
2. Planulati. Jura, Chalk. *A. annulatus*, Sowb. (xxxiv, 47, 48).
3. Ligati. Cretaceous. *A. ligatus*, d'Orb. (xxxiv, 49, 50).
4. Globosi. Alpine Trias.
5. Heterophylli. Jura, Alpine Trias. *A. heterophyllus*, d'Orb. (xxxiv, 51, 52).

B. Whorls dorsally flattened.

6. Capricorni. Jura. *A. capricornus*, Schloth. (xxxiv, 54, 55).
7. Armati. Jura. *A. longispinus*, Sowb. (xxxiv, 56, 58).
8. Coronarii. Jura, Chalk. *A. Blagdeni*, Sowb. (xxxiv, 57, 59).
9. Macrocephali. Jura. *A. Herveyi*, Sowb.
10. Compressi. Chalk. *A. Beaumontianus*, d'Orb. (xxxiv, 53, 60).

C. Dorsally channeled.

11. Dentati. Jura, Chalk. *A. mamillaris*, Schloth. (xxxv, 61, 62).

D. Dorsally keeled, keel entire.

12. Arietes. Lias. *A. bifrons*, Brug. (xxxv, 63). *A. bisulcatus*, Brug.
13. Falciformi. Jura. *A. serpentinus*, Schloth. (xxxv, 65, 66).
14. Cristati. Chalk. *A. cristatus*, Deluc. (xxxv, 67).

E. Dorsal keel crenated.

15. Amalthei. Jura. *A. cordatus*, Sowb. (xxxv, 68, 69).
16. Rothomagenses. Chalk. *A. rothomagensis*, Brong. (xxxv, 70).

F. Dorsally sharp-edged.

17. Disci. Chalk. *A. Metternichii*, Hauer (xxxv, 71).

Prof. Alpheus Hyatt, in his article on "Fossil Cephalopods," published in the *Bulletin of the Museum of Comparative Zoology*, i, 71, regards the Ammonoids, including all the cephalopods with serrated or foliated septa, the Clymeniaæ, Goniatites, Ceratites, and Ammonites proper, "as a distinct order from the Nautiloids and Dibranchiate Cephalopods;" the typical group of this order being the so-called genus Ammonites. This enlarged view of the systematic position of the Ammonoids is by Prof. Hyatt attributed to Prof. Agassiz, but it is evident that von Buch had a glimmering of the same idea, because his groups (mainly those I have enumerated above), although permitted by him to remain under the generic name Ammonites, were designated as "families." Prof. Edward Suess, also, regarded the genus Ammonites as a family, the typical groups of which were of generic rank; and recently Dr. Paul Fischer adopts for them the order Ammonea.

Prof. Hyatt reverses the use of "dorsal" and "abdominal" in his descriptions of the shells; inasmuch as the animal of Nautilus and Ammonites is placed with its abdominal side to the periphery of the shell, he calls this outer side of the latter "abdominal," and the inner or sutural side "dorsal." I regard

this reversal of terms as objectionable, inasmuch as their exceptional use in the shells of tetrabranchiates must give rise to great confusion. He uses also the word "pilæ" for ribs, and "geniculæ" for the knees of the ribs.

A clear exposition of the reversed position of the animal of the tetrabranchiate, in relation to its shell, may be found in a paper by Prof. Owen, *Zool. Proc.*, 955, 1878.

Neumayr (1875) and Mojsisovics (1879, 1882) proposed systematic arrangements of the Ammonitidæ which agree in most of the main groups, but differ in details. The former dismisses Prof. Hyatt's classification (limited to Liassic species) with scant notice, his genera not being even enumerated, "because they do not agree with natural groups." I believe that both Hyatt and Neumayr would find it difficult to correlate their respective genera. The attempt has been made, however, by Dr. Paul Fischer in his excellent "*Manuel de Conchyliologie*," and if the result has not been satisfactory in all cases, it is at least far preferable to perplexing the student with three or more sets of generic names and diagnoses by presenting the several classifications in succession. I adopt Dr. Fischer's conscientious arrangement for the present, and hope that it will, as soon as may be, give place to a better grouping.

Siphonal neck of the septa directed backwards (Retrosiphonata).
Goniaticæ.

Siphonal neck of the septa directed forwards (Prosiphonata).

No Aptychus, or corneous Anaptychus of one plate (Anaptychidea).

First saddle of the suture broad (Latisellata). Arcestæ, Tropitæ, Ceratitæ, Clydonitæ.

First saddle narrow (Angustisellata). Pinacoceræ, Amaltheæ, Ammonitæ, Lytoceræ, Phylloceræ.

Aptychus calcareous, double, or of two valves soldered together (Aptychidea). Harpoceræ, Stephanoceræ.

As Dr. Fischer regards the Ammonitidæ as an order, he has given the family termination to the above names: they will here be considered as group-names for assemblages of genera of the family Ammonitidæ. The position and appearance of the lobes and saddles of the septal sutures are represented and explained, ii, 22, 28; xxxii, 31; xxxiii, 41; xxxiv, 51, 52; xxxv, 72.

Goniaticæ.

Shell nautiloid; siphonal neck of the septa directed backwards. Siphon excentric. First whorls of the spire sometimes contiguous and covered as in *Ammonites*, sometimes not in contact, as in those of *Spirula*.

CLYMENIA, Münster, 1834.

Etym.—*Clymene*, a sea-nymph.

Syn.—Endosiphonites, Ansted, 1840; Planulites, Münster, 1832.

Distr.—37 sp. Devonian; Germany, England. *C. undulata*, Münster. (xxx, 11). Fichtelgebirge.

GONIATITES, DeHaan, 1825.

Etym.—*Gonia*, angles. *Syn.*—*Aganides*, Montfort, 1810.

Distr.—About 320 sp. U. Silurian to Carboniferous; Europe, America, Australia. *G. Henslowi*, Sowb. (xxxii, 19). Carb. limestone; Isle of Man.

Shell spiral, discoidal; sutures of septa lobed; siphuncle dorsal, its tubes directed backwards; septa concave; margin of the aperture sinuous. Aptychus a single corneous plate. The genus reached its maximum development in the Devonian period. The shell of Goniatites being very variable in form and the species numerous, Beyrich, Sandberger and others have divided them into sections, which will probably, as in the case of Ammonites, form distinct genera hereafter. Sandberger uses the characters of the sutural line for his groups, as follows:

1. *Linguati*. Lobes and saddles linguiform, rounded.
2. *Lanceolati*. Lobes narrow, lanceolate; saddles rounded, claviform.
3. *Genufracti*. Second lateral saddle greatly developed, forming nearly a right-angle with the second lateral lobe; ventral lobe small.
4. *Serrati*. Lobes and saddles narrow, sharp, like the teeth of a saw.
5. *Crenati*. Ventral lobe very small; lateral saddle very large, rounded, separated from the rounded ventral saddle by a sharp lobe.
6. *Acutolaterales*. Ventral lobe simple, a lobe and sharp saddle on each side.
7. *Magnosellares*. Lateral saddle short and wide, lateral lobe rounded, ventral lobe thin.
8. *Nautilini*. Ventral lobe narrow; sutural lines simply arcuated on the sides.

In some of the Goniatites the first whorls are not in contact, recalling the shell of Spirula.

Arcestæ.

Shell smooth or with transverse folds, ribs or striæ; wrinkled layer consisting mostly of linear, interrupted striæ; impressions of the mantle attachment without or with a but slightly contracted opening always visible on the body-chamber. Anaptychus apparently horny in Arcestes.

ARCESTES, Suess, 1865.

Distr.—130 sp., Trias; several sp. Permian, and Carboniferous of India; 1 sp. Trias, N. Caledonia. *Arcestes tornatus*, Bronn (xxxviii, 20, 21).

Shell, as a rule, smooth, sculptureless, seldom with longitudinal striæ (Tornati); body-chamber long, taking up one to one and one-half whorls. Whorls strongly involute. Aperture usually contracted by the border being reflected inwards or by internal ridges. Lobes strongly incised (lacinated), so that the saddles merely consist of a slender stem with numerous approximated horizontal branches, which in turn are divided into smaller branchlets.

Many forms have internal nuclei with an open umbilicus, and a terminal whorl with a callous closed umbilicus.

ARCESTES (restricted). Last whorl of the spire more or less modified in form; umbilicus closed by a callous deposit.

SPHINGITES, Mojs., 1879. Surface of the last whorl sillonated; umbilicus open.

CLADISCITES, Mojs., 1879. Section of the whorls subquadrangular, their form not modified in the adults. The character of the suture recalls the Pinacoceræ; second lateral lobe deep, saddles slender, much divided.

JOANNITES, Mojs., 1879. Sutural lines like those of Cladiscites, but the other characters those of Arcestes. The sutural line is arcuated, lobes and saddles partly divided in pairs, much toothed.

DIDYMITES, Mojs., 1873. External form and length of body-chamber same as in Arcestes; shell with sharp lines of growth and plicate wrinkles throughout the whole length of the body-chamber to the aperture; on the inner convex surface of the shell there is a median furrow; the last whorl is constricted near the aperture.

The sutural lines of the septa are formed of few-toothed saddle pairs, which often alternate with single saddles. These saddle pairs, as is shown by projection of the spiral, correspond each to two saddles in the other genera of Ammonites.

Didymites contains but a few Triassic forms. *Didymites angustilobatus*, Hauer (xxxix, 32, 33).

CYCLOLOBUS, Waagen, 1879.

Distr.—*C. Oldhami*, Waagen (xxxvi, 93, 94). Palæozoic; India.

Shell spiral, smooth, with a small deep umbilicus; whorls numerous, somewhat compressed, with a broadly rounded external side, deeply embracing each other so as to envelop the preceding whorl, entirely covered on the sides with not very numerous contractions of the shell (varices), indicating very likely the remnants of old apertural margins. The form of these varices is somewhat falciform, with a strong bend towards the front in the middle of the sides of the whorl, and being bent

considerably backwards towards the external margin, entirely disappearing on the siphonal side of the shell. The increase in height of the whorls is very slow.

Closely related to *Arcestes*, of which it may be only a sub-genus.

LOBITES, Mojs., 1873.

Syn.—*Coroceras*, Hyatt, 1877. *Clydonites*, Laube, non Hauer.

Distr.—Nine Triassic species are enumerated. *L. delphinocephalus*, Hauer (xxxvi, 92). *L. ellipticus*, Hauer (xl, 58, 59).

In external form and length of body-chamber agreeing with *Arcestes* and *Didymites*. Shell usually with tranverse folds, which are frequently crossed by fine longitudinal striæ. The body-whorl frequently assumes a form very different from the inner ones, and not unfrequently closes the umbilicus with a callus. Towards the aperture, however, and always in those forms with a closed umbilicus, there is a constriction which extends forwards in the form of small, projecting, lateral lobes. The sutural lines of the septa consist of entire-margined, high saddles, somewhat contracted at their bases, which vary in height in such a way that the second and fourth are perceptibly lower than would be expected from their position. A high siphonal process.

In many forms there appears, regularly at the end of the body-whorl and the one next to it, a portion constricted off the "hood;" in other forms the aperture is simple, and only prolonged anteriorly into lobe-like processes at the convex portions, and but little or not at all constricted.

In *Lobites* the derivation from the goniatitic ancestry is much more striking than in any other mesozoic genus, inasmuch as the form of the lobes is still completely goniatitic. The ammonitic stage is indicated in the structure of the lobes only by the high siphonal process dividing the external lobe.

Tropitæ.

Shell more or less richly ornamented, provided with radial ribs, which almost always support on the edge of the convex portion (frequently also on the sides) knobs and spinous processes. Wrinkled layer and impressions of the mantle attachments entirely absent.

TROPITES, Mojs., 1875.

Distr.—11 Triassic species. *Tropites Ramsaueri*, Quenst. (xl, 52, 55, 56).

Body-chamber long, embracing one and three-quarters to one and one-half whorls. The strong sculpture is interrupted on the convex portion of the shell; frequently a median keel is present on the same. At the aperture the convex portion is prolonged

into a broad, short lobe. The last whorl frequently differs in form and sculpture from the inner whorls. The lobes are distinguished by their broad saddle stalks, with divisions cut in obliquely, the oblique position of the tips of the lobes, great development of the principal lobes, and striking reduction of auxiliary ones.

HALORITES, Mojs., 1879. Body-chamber and spiral of the whorls as in *Arcestes*. Inner whorls with granulose ribs; saddles elevated, with many narrow lateral branches; lateral lobes reduced; last whorl with a different form and sculpture from the others; aperture a little contracted; a wrinkled layer present.

JUVAVITES, Mojs., 1879. Differs from *Halorites* by its last whorl resembling the preceding ones, and its less dentate lobes; the shell bears traces of periodical contractions.

DISTICHITES, Mojs., 1879. Convexity of the shell with a median groove, usually bordered by carinæ; inner whorls having the ornamentation of *T. Jockelyi*; last whorl with additional ribs intermediate to those which ornament the preceding whorls; body-chamber occupies more than a whorl; lobes as in *Sagenites*.

EUTOMOCERAS, Hyatt, 1877.

Distr.—*E. Laubei*, Meek (xxxvii, 6, 7). Trias; Nevada.

Characterized by its lenticular form, narrow umbilicus, apparently at all ages very sharp external keel, without furrows or lateral ridges, and small regular arched pilæ on middle-sized specimens, growing wider, more irregular, less distinct, and developing small lateral lobes on the adult, with both nodes and pilæ becoming obsolete on the larger part of the body-volution.

Ceratitæ.

CERATITES, de Haan., 1825.

Syn.—*Haaniceras*, Bayle, 1878.

Distr.—Permian, Trias. The Cretaceous forms referred to *Ceratites* perhaps belong to another group. *C. nodosus*, Brug. (xxxii, 23).

Shell discoidal, more or less sculptured; sutural line with simple, rounded saddles, and shallow denticulated lobes; anti-siphonal lobe doubly toothed.

TIROLITES, Mojs., 1879. Lobes not toothed, or showing the commencement of teeth; second lateral lobe more or less salient; convexity of the whorls smooth, rounded, nearly flat. *C. Idrianus*, Hauer.

BALATONITES, Mojs., 1879. Periphery with a tuberculated carina. *C. Balatonicus*, Mojs.

HUNGARITES, Mojs., 1879. Shell narrow, with a much elevated median carina; lobes as in *Ceratites*. *C. Zalaensis*, Böckh.

ACROCHORDICERAS, Hyatt, 1877. This group is closely allied to

Lytoceras and *Phylloceras*, Suess, and *Haploceras* of Zittel, combining characteristics which are found in all of these, besides having peculiar characters of its own, and a different development. The extent of involution is comparable with that of *Haploceras*, but the whorl itself is about intermediate between the extreme roundness of *Lytoceras* and the more flattened sides of *Phylloceras*. Its peculiar characteristics consist in having large lateral tubercles and exterior pilæ, which are united as they near the tubercles. The smooth zone along the outer centre in the young is also probably of subgeneric value. *C. Hyatti*, Meek (xxxvii, 14). Trias; Nevada. Hyatt makes this a distinct genus of his family *Physanoidæ*, but Mojsisovics and Fischer class it as a group of *Ceratites*.

MEEKOCERAS, Hyatt, 1879. Distinguished from *Ceratites* by having but three distinct lateral cells and two lateral lobes, besides the finer auxiliary lobes and cells. The typical *Ceratites* have at least four distinct lateral cells and lobes besides the auxiliary ones, and the distinction is slight between the two series; in this genus, on the contrary, the auxiliary series, when present, is not divided from the third lateral cell by a distinct lobe, as in *Ceratites*, and the aspect of the third lateral cell is often like that of a *Goniatites*. The compressed whorls of all the species is of course a characteristic which is obvious when they are contrasted with typical *Ceratites*, as is also the absence, or merely transient appearance, of heavy nodes and ribs, except perhaps in the least involute species. *C. aplanatum*, White. Triassic; S. E. Idaho.

XENODISCUS, Waagen.

Distr.—*X. plicatus*, Waagen (xxix, 91, 92). Productus. Limestone (Carboniferous); India.

Shell flat discoidal, with compressed whorls, perfectly rounded on the siphonal side; umbilicus mostly large, and the whorls generally only slightly embracing each other; surface smooth, or with distant rounded folds which are thickest near the umbilical margin of the whorls, or with numerous slight plications which are straight on the sides of the whorls, and slightly turned towards the front near the siphonal margin; the sutures are very simple; the siphonal and two lateral lobes always well-developed, also a sutural lobe generally, but auxiliary lobes are generally absent. The lobes are furnished with a slight indentation at their termination, the saddles rounded, entire, without any indentation; the internal sutures show only one large antisiphonal lobe, which terminates in two long, sharp points; the body-chamber occupies not quite one whorl; aperture simple.

TRACHYCERAS, Laube, 1869.

Distr.—16 Triassic sp. *T. bicrenatus*, Hauer (xxxviii, 30, 31). *T. Whitneyi*, Gabb (xxxvi, 81, 89). Trias; Nevada, California.

Body-chamber short, one-half to two-thirds of a whorl long. The sculpture on the convex portion is interrupted; in the geologically younger forms a more or less deep median furrow is sunken in, at which the ribs terminate in a tubercle. Aperture with a short lobate process on the convex portion. Lobes agreeing with Tropites; much simpler in the geologically older forms.

ARPADITES, Mojs., 1879. Periphery with a deep groove, sometimes bordered by smooth or nodulous carinations; ribs numerous, dichotomous from an umbilical nodosity. The older forms have entire saddles; the more recent ones are toothed to the summit. *T. Arpadis*, Mojs.

HERACLITES, Mojs., 1879. Body-chamber only occupying half a whorl; ribs strong, nodulous on the sides; periphery of the last whorl flattened, with two thread-like spiral lines; lobes distinguished by several irregular notches, but deeply truncate. *T. Pöschli*, Hauer.

SAGENITES, Mojs., 1879. Body-chamber occupying half or three-quarters of the whorl; ribs usually not interrupted at the periphery, crossed by very close spiral lines; saddles high and wide, branched, foliaceous; lobes branched; auxiliary lobes very small. *T. Giebeli*, Hauer.

GYMNOTOCERAS, Hyatt, 1877.

Distr.—*G. rotelliforme*, Meek (xxxvi, 90, 91). Trias; Nevada.

The development of *Ammonites Blakei*, Gabb, and the characters of its periphery, separate it at once most decidedly from any species of Trachyceras. The development generally of a keel, or, in some varieties, of a raised periphery, over which the pileæ do not pass, shows that this is a different genus, characterized by a different mode of development. The septa are quite similar to those of Trachyceras, but it is very evident that in the Trachyceræ the septa cannot be looked to for generic differences. Great differences also occur in the amount of involution of the different species and in the development of their external characters.

Clydonitæ.

Body-chamber short; sutural line undulated; lobes and saddles simple, not dentate.

CLYDONITES, Hauer, 1860.

Ety.—*Kludon*, the surge.

Distr.—21 sp.; Upper Triassic; Europe, Himalayas. 2 sp.; Upper Cretaceous (described by d'Orb. as Ceratites. Difference from Ceratites is the lobes being simple, not crenulated). *C. costatus*, Hauer (xxxii, 27). *C. delphinocephalus*, Hauer (xxxii, 28).

Shell spiral, discoidal, whorls involute, ribbed; sutures simply lobed, the lobes pointed.

COROCERAS, Hyatt, 1877. The species all have numerous lobes and saddles, with smooth sutures, and a large exterior lobe which is very broad and prominent; they are plicately ribbed and very involute, the umbilicus nearly covered; mouth more or less hooded or constricted. *C. ellipticus*, Hauer (xxxvii, 8, 9).

CHORISTOCERAS, Hauer, 1875.

Distr.—9 sp. Trias. *C. Marshi*, Hauer.

Shell discoidal; body-chamber short; ribs interrupted by the convexity of the inner whorls, but continuous on the outer.

HELICITITES, Mojs., 1879. Whorls with strong, uninterrupted ribs; lobular line undulated, with small, almost microscopic denticulations. *C. geniculatus*, Hauer.

BADIOLITES, Mojs., 1879. Convexity of the whorls narrow and carinated; ribs falciform; lobes not truncate, undulated, except the antisiphonal lobe, which is long and pointed. *C. eryx*, Münster.

RHABDOCERAS, Hauer, 1860.

Distr.—*R. Suessii*, Hauer. Alpine Triassic; Germany (xxxii, 20, 21).

Shell straight, orthoceratoid, strongly sculptured; septa with rounded lobes.

Rod-like, elongated forms with oblique annular sculpture and simple curved lobes; still very imperfectly known.

COCHLOCERAS, Hauer, 1860.

Etym.—*Cochlos*, a snail-shell, *ceras*, a horn.

Distr.—3 sp. Alpine Triassic; Hallstadt, Austria. *C. Fischerii*, Hauer (xxxii, 25, 26).

Shell spirally elongated, scalariform, strongly sculptured; sutures of septa with several simple rounded lobes.

The whorls are spirally coiled to the left, with continuous ribs and simple curved lobes.

Pinacoceræ.

Body-chamber short, half or three-quarters of the last whorl; shell flattened, discoidal; sutural line very complex, with three groups of lobes adventive, principal and auxiliary).

PINACOCERAS, Mojs., 1873.

Syn.—Megaphyllites and Carnites, Mojs., 1878.

Distr.—12 sp. from the Triassic. *P. Melternichii*, Hauer, (xxxv, 71).

Shell narrow, aperture high, smooth, seldom with knob-like enlargements on the surface. Body-chamber one-half to two-thirds of a whorl long; aperture with short lobular process of the convex portion. Attachment ring commencing a short distance from the aperture and extending to the posterior end of

the body-chamber. Impressions of the mantle attachment punctate or striate. Wrinkled layer consisting of broken-up striae. The sutural line of the septa is distinguished by the presence of external adventitious lobes. Three groups of lobes may accordingly be distinguished: 1. The adventitious lobes. 2. The three principal lobes. 3. The auxiliary lobes. The adventitious and auxiliary lobes always present a similar structure, whilst the principal lobes frequently present a peculiar form.

SAGECERAS, Mojs., 1873.

Distr.—7 sp. Permian and Triassic. *Sageceras Haidingeri*, Hauer (xl, 48, 49).

Close to *Pinacoceras* in the form of the shell and length of the body-chamber, and differs from it in the structure of the wrinkled layer, the form of the lobes and the direction of the lines of growth in the concave portion. The wrinkled layer is coarsely granular, as in *Nautilus*, and does not consist of long striae and threads, as in the *Arcestæ*. The saddles are slender, narrow, tongue-like, entire, the lobes symmetrically divided, simply or doubly, by simple conical teeth. Three groups of lobes, as in *Pinacoceras*. The lines of growth do not trend backwards, as in *Pinacoceras*, but forwards.

Sageceras is already fully developed in the Permian formations, though in these older forms the siphonal process characteristic of the Ammonite stage is wanting.

NOVITES, Mojs., 1878. Wrinkled layer striated; an adventive saddle not reaching the height of the first principal saddle; saddles narrow, elevated, rounded at their superior extremity; lobes but little truncate; first principal lobe divided. *S. Caprilensis*, Mojs.

MEDLICOTTIA, Waagen, 1880. Siphonal side (periphery) either excavated and rounded on both sides by high and sharp crests, or simply flattened, and defined on both sides by angular margins. In both cases the high and narrow saddles developed on each side of the siphonal lobe are situated exactly below the crests or the angulated margins; these saddles are strongly serrated from both sides, and the denticulations of the opposite sides of the saddle correspond exactly with each other. *M. Wynnei*, Waagen (xxxix, 43, 44). Productus Limestone (Carboniferous); India.

OTOCERAS, Griesbach, 1881.

Distr.—*O. Woodwardi*, Griesb. (xxxix, 40–42). L. Triassic; Himalayas.

Shell involute, with very deep umbilicus, and rapidly increasing outer whorls; the part nearest the umbilicus bulged out into an ear-like shape, giving the section of the shell a more or less rhomboidal aspect. It is very probable that in adult individuals the last whorl covered and enclosed the entire preceding shell.

Amaltheæ.

Shell generally flattened and carinated, the last whorl of the spire covering a large part of the preceding; sutural line with several auxiliary lobes. Aptychus simple, corneous, only known in the Jurassic forms.

AMALTHEUS, Montfort, 1808.

Distr.—68 species. Triassic, Jurassic and Cretaceous. *A. margaritatus*, d'Orb. (xxxviii, 26, 27).

Periphery sharpened or carinate; ribs when present, absent at this part or broken up into tubercles or folds; the geologically older forms with spiral striae on the external layer of the shell, which corresponds to the wrinkled layer of the *Arcestæ*. Body-chamber short, one-half to two-thirds of a whorl long; margin of aperture simply emarginate, with long, external processes, ending in spoon-shaped extremities, sometimes bent outwards or inwards. Lobes usually strongly incised, siphonal lobe shorter than the first lateral, lobular bodies broadly wedge-shape. Umbilicus open, with the sides of the whorls exposed or only partially covered.

PLEUROCERAS, Hyatt, 1868. (*Prionotropis*, Meek, 1876.) Periphery flat, with keel and channels well defined; keel crenulated; channels vary from obsolete to deep and well-defined, pilæ swelling below, tuberculated; genicular bend prominent. Tubercles lateral, arranged along the line of envelopment. Umbilicus open. Ventral lobe narrow and but slightly deeper than the lateral lobes; the latter unequally divided. Inferior lateral lobe small, shallow, equally divided. Superior lateral cell only partly exposed on the side, and together with the inferior lateral, unequally divided. Scarcely distinct from *Amaltheus*. Middle Lias, Cretaceous. *A. spinatus*, Brug. (xxxviii, 24, 25). *A. (Prionotropis) Woolgari*, Mantell (xxxvii, 10, 11).

OXYNOTICERAS, Hyatt, 1874. Periphery carinated in the young shell, rounded in the adult. *A. Guibalianus*, d'Orb. (xl, 50, 51). Lower Lias.

PTYCHITES, Mojs., 1875. Shell covered with undulated radiating plications; exterior lobe shallow; exterior saddle but little elevated; first lateral saddle very high; saddles dentate or slightly branched. This group, which corresponds to the *Plicosi* of Beyrich and the *Rugiferi* of Oppel, may be considered an ancestral form of *Amaltheus*. Six Triassic species. *A. Studeri*, Hauer.

SCHLOENBACHIA, Neumayr, 1875.

Dedicated to the geologist, Schloenbach.

Syn.—*Mortoniceras*, Meek, 1876.

Distr.—46 species. Cretaceous; Europe and United States.

S. cristata, Deluc. (xxxv, 67). *S. (Mortoniceras) vespertinus*, Morton = *S. Texanus*, Roemer (xxxvi, 86).

This genus embraces the very natural group of *Cristati*; to these may be added *Schl. Germari*, Reuss., whose affinity to these is indicated, besides other striking characters, by a toothed keel. Shell strongly keeled, usually with strong ribs curved forwards on the flanks; body-chamber two-thirds of a whorl long, drawn out at the sickle-shaped aperture into a long, beak-like process, which is either prolonged in conformity with the curvature of the spiral or bent outwards. Siphon very stout, usually lying in the keel, which is often cut off from the lumen of the shell by a calcareous septum. Lobes not much branched, with bodies which are narrower than the saddles; only one distinct auxiliary lobe; which is wanting in some forms. Siphonal lobe usually as long or longer than the first lateral. In some species a great reduction in the number of branches of the lobes takes place, so that they approach a *Ceratitic* form. (*Schl. senequeri* and *halophylla*.)

PLACENTICERAS, Meek, 1870.

Distr.—Cretaceous; United States, India. *A. placenta*, DeKay (xxxvi, 82).

Shell with the very narrow periphery truncated, and often provided with a row of compressed alternating nodes along each margin; volutions about three-fourths embraced by the next succeeding outer one; septa with the lateral sinuses provided with more or less branched and digitate terminal divisions; umbilicus small or moderate.

SPHENODISCUS, Meek, 1872. Shell with periphery cuneate; umbilicus very small; volutions each almost entirely embraced by the succeeding one; septa with the first five or six lateral sinuses provided with only a few short, nearly simple, obtuse divisions; while the others are simple, and usually broadly reniform at the ends. Cretaceous; United States, Europe. *Amm. lobatus*, Tuomey.

Meek thinks that some of the species of *Pinacoceras*, Mojsisovics, will fall into this group; and that that genus is too comprehensive. *Sphenodiscus* equals the *Clypeiformi* group of *Ammonites*.

NEOLOBITES, Fischer, 1882. Shell flattened, sharply carinated; lobes and saddles simple, not truncate, resembling those of the triassic *Lobites*. *P. Vibrayeanus*, d'Orb. Cenomanian.

BUCHICERAS, Hyatt, 1875.

Dedicated to Dr. L. von Buch, a German naturalist.

Distr.—Cretaceous. *B. Syriacum*, Buch.

Shell ornamented with strong ribs, dichotomous, from tubercles near the umbilicus; ribs interrupted at the periphery; lobes

shallow, but little truncate and resembling those of *Ceratites*; saddles not high, rounded, simple or slightly divided; siphonal saddle small; some auxiliary lobes.

Founded on the cretaceous species of *Ceratites*, which differ from the triassic forms in the characteristics of the sutural outlines: they are not *Ceratites* at all, but, strictly speaking, *Ammonites*.

Ammonitæ.

Spire-whorls narrow, exposed, with radiating ribs; aperture simple; sutural line normal, without accessory lobes. *Aptychus* a single corneous plate.

AMMONITES (Breyn., 1732), Lamarck, 1801.

Etym.—*Ammon*, a surname of Jupiter.

Syn.—*Arietites*, Waagen, 1869. *Coroniceras*, Hyatt, 1867. *Asteroceras*, Hyatt, 1867. *Arnioceras*, Hyatt, 1867. *Discoceras*, Hyatt, 1867.

Distr.—40 sp. Jurassic, Liassic. *A. (Asteroceras) obtusus*, Sowb. (xxxvi, 79, 80; xxxiii, 44). *A. (Arnioceras) Kridion*, Orb. (xxxvii, 100, 1). *A. (Coroniceras) bisulcatus*, Brong. (xxxv, 64). *A. (Discoceras) Ophidioides*, d'Orb. (xxxvii, 98, 99).

Shell discoidal, flattened, whorls exposed, ornamented with inflected ribs becoming nodulous at the periphery; periphery carinated, with a groove on each side of the keel, and another carina outside the groove; section of the last whorl subquadangular; body-chamber very long, sometimes exceeding a whorl; aperture simple, with a sharp, not inflected peripheral prolongation; sutural line with a ventral lobe longer than the lateral superior lobe, the latter higher than all the others; inferior lateral lobe wide; antisiphonal lobe two-pointed.

The above diagnosis is of *Ammonites* as restricted by modern naturalists: the ancient genus, before its dismemberment, contained two or three thousand species, and was divided into sections (p. 63), many of which correspond to modern genera.

CALOCERAS, Hyatt, 1870. (*Ophioceras*, Hyatt, 1867. *Echioceras*, Bayle, 1878.) Ribs not arcuated; carina of the periphery sometimes not very distinct, without grooves. *A. torus*, d'Orb. (xxxvi, 77, 78).

EUDISCOCERAS, Hyatt, 1877. This type is distinguished by its discoid form, open umbilicus, and a keel, bordered by furrows and ridges, the latter being interrupted or tubercular; the young with comparatively large pilæ, growing smaller and more flexuous in the adult, and finally fading away in the larger half of the body-volution. *E. Gabbi*, Meek (xxxvii, 4, 5). Trias; Nevada.

AGASSIZICERAS, Hyatt, 1874. Ribs slightly arcuated; carina not bordered by grooves. *A. Scipionianus*, d'Orb. (xxxviii, 22, 23).

LILLIA, Bayle, 1878. In the young shell the ribs are simple or bifurcated, commencing with tubercles at the umbilical region; later the ribs are simple and the shell resembles Agassiziceras. Perhaps this group would be better placed near Harpoceras: the limit between the latter genus and Ammonites is very difficult to trace, without the aid of the aptychus.

ÆGOCERAS, Waagen, 1869.

Syn.—Myroceras, Hyatt, 1867. Androgynoceras, Hyatt, 1867. Liparoceras, Hyatt, 1867. Deroceras, Hyatt, 1867. Peronoceras, Hyatt, 1867. Platypleuroceras, Hyatt, 1867. Cycloceras, Hyatt, 1867. Psiloceras, Hyatt, 1867.

Distr.—4 Cretaceous, 54 Liassic species. *Ægoceras (Microceras) biferum*, Quenst. (xxxvii, 96, 97). *Æ. (Androgynoceras) hybridum*, Hyatt (xxxvi, 83, 84). *Æ. (Lyparoceras) Henleyi*, Sowb. (xxxvi, 85). *Æ. (Deroceras) Ziphius*, Ziet. (xxxvii, 95). *Æ. (Peronoceras) muticum*, d'Orb. (xxxviii, 13, 14). *Æ. (Platypleuroceras) latecostatum*, Sowb. (xxxviii, 19). *Æ. (Cycloceras) Valdani*, d'Orb. (xxxix, 34, 35). *Æ. (Psiloceras) psilonotum*, Quenst. (xxxvii, 2, 3).

Shell mostly compressed, composed of many whorls, embracing but little, sometimes provided with nodose or externally bifurcate ribs; never with true sickle-like ribs; not carinate; body-chamber usually a whorl long, in the geologically younger forms somewhat shorter. Aperture simple without lateral appendages, with very weak external lobes and a constriction; a single corneous aptychus. Lobular line strongly notched, upper lateral longer than the siphonal, lower lateral not always present; usually with a depending siphonal lobe. Lobular bodies narrow, not wedge-shaped; antisiphonal two-pointed.

The true *Ægoceras* died out in the middle Lias.

Ægoceras corresponds to the group Ammonites Capricorni of Buch.

SCHLOTHEIMIA, Bayle, 1878. Ribs meeting exteriorly, where they form an angle directed towards the aperture. *Æ. angulatum*, Schloth.

Lytocerae.

Body-chamber short, two-thirds of the last whorl; aperture simple. No aptychus.

LYTOCERAS, Suess, 1865.

Syn.—Thysanoceras, Hyatt, 1867.

Distr.—62 species from the Trias, Jura and Cretaceous. *L. Henleyi*, Sowb. (xxxvi, 85). *L. Moreleti*, Hauer (xxxviii, 28, 29). *L. (Thysanoceras) fimbriatus*, Sowb. (xxxiii, 45, 46).

Shell flattened, discoidal, whorls but little involute or simply in contact; body-chamber two-thirds of a whorl, margin of aper-

ture at the columellar side produced into a lobe, processes wanting at the siphonal side and on the flanks; lines of growth and sculpture parallel to the margin of the aperture, at the suture bent forwards; sculpture feeble, mostly consisting of radial lines or interruptions; sutural line with few lobes, lateral lobes and saddles symmetrically divided, columellar lobe two-pointed. No aptychus.

The forms of the Trias diverge herefrom in such a way, that in them the lines of growth and sculpture, as in *Phylloceras*, are directed forward at the siphonal side, and that the structure of the saddles is monophyllic.

Lytoceras corresponds to the Fimbriati group of *Ammonites*.

MONOPHYLLITES, Mojs., 1879. Differs in the saddles being monophyllic. *L. sphærophyllum*, Hauer.

OPHICERAS, Griesbach, 1881. Compressed; section of whorls oval and widening near the umbilicus, the latter large and shallow; thick, covered with fine wrinkles or growth-lines of sigmoid shape, becoming fine ribs in the body-chamber; at irregular intervals the shell swells into rounded bumps, largest near the umbilical margin; the periphery is rounded, and the wrinkles or folds run across it and join with those of the other side. Both in general shape and number and arrangement of the lobelines, this subgenus closely resembles the *Lytoceratite* groups *Monophyllites* and *Phylloceras*, and it may be said to be an earlier stage of those forms. *C. Tibeticum*, Griesb. (xl, 45). L. Trias; Himalayas.

PHYLLOCERAS, SUSS, 1865.

Syn.—*Rhacoceras* (Agassiz), Hyatt, 1867.

Distr.—77 sp. Triassic, Jurassic, Cretaceous. *P. oculum*, Mojs. (xxxix, 38, 39). *P. (Rhacoceras) heterophyllum*, Sowb. (xxxiv, 51, 52).

Shell discoidal, involute, with feeble sculpture, sometimes with constrictions or varices, lines of growth directed forwards; body-chamber short, margin of aperture simple with somewhat produced lobes on the external side; no aptychus; lobes numerous, diminishing regularly in size, laterals without subdivision into principal paired branches; leaves or lobes of the saddles very much rounded; antisiphonal lobe two-pointed.

This genus is remarkable for its persistence in the secondary strata. The triassic forms are characterized by their less numerous lobes, and more open umbilicus. Prof. Meek includes a few American cretaceous species in the genus.

Harpoceratæ.

Aperture with more or less developed lateral ear-like prolongations; sutural line with accessory lobes; surface ornamented

with straight or curved radiating ribs. *Aptychus* calcareous, grooved, formed of two plates.

HARPOCERAS, Waagen, 1869.

Syn.—Grammoceras, Hyatt, 1867. Leioceras, Hyatt, 1867. Lioceras, Bayle, 1878. Hammatoceras, Hyatt, 1867. Ludwigia, Bayle, 1878. Phymatoceras, Hyatt, 1867. Pelecoceras, Hyatt, 1867. Tropicoceras, Hyatt, 1867. Waagenia, Bayle, 1878. Sonninia, Bayle, 1878.

Distr.—96 sp. Jurassic. *Harpoceras* (*Tropicoceras*) *Actæon*, d'Orb. (xxxviii, 17, 18). *H.* (*Grammoceras*) *serpentinum*, Schl. (xxxv, 65, 66). *H.* (*Leioceras*) *complanatum*, Brug. (xxxix, 36, 37). *H.* (*Hammatoceras*) *insignis*, Schloth. (xxxviii, 15, 16).

External form of the shell variable, outer side always carinate or angular; sculpture consisting of more or less distinct sickle-like ribs. Margin of aperture sickle-shaped, or with ears, with pointed external lobes; body-chamber embracing one-half to two-thirds of a whorl, carinate to the margin of the aperture. *Aptychus* divided, thin, calcareous, with a thick, shelly layer, more or less folded.

Lobes mostly not deeply notched, always two lateral lobes and almost always auxiliaries. Siphonal lobes ending in two diverging branches, usually shorter than the first lateral; laterals not divided into symmetrical halves.

This genus corresponds to Buch's group *Ammonites Falciferi*.

HILDOCERAS, Hyatt, 1867. Carina bordered on either side by a groove. *H. bifrons*, Brug. (xxxv, 63).

OPPELIA, Waagen, 1869.

Dedicated to the palæontologist, Oppel.

Syn.—Neumayria, Bayle, 1878. Œcotraustes, Waagen, 1869.

Distr.—71 sp. *O. subradiata*, Sowb. (xl, 57). *O.* (*Neumayria*) *fulgens*, Trautsch. (xxxix, 88, 89).

Shell with umbilicus usually narrow, external side either rounded only on the body-chamber or on all the whorls. Sculpture sickle-shaped, body-chamber frequently geniculate, never carinate or angular, embracing one-half to two-thirds of a whorl; margin of aperture sickle-shaped or with ears, always with rounded external lobes. Siphon stout with calcareous sheath. Lobes moderately branched, siphonal mostly shorter than the first lateral; lobular bodies slender with almost parallel edges; lateral lobes divided into two principal symmetrical branches. *Aptychus* divided, calcareous, thick, folded (*Apt. lamellosus*); muscles of attachment near the margin in the lower half of the shell.

Oppelia branches off in the lower Oolite with *Opp. subradiata* from *Harpoceras*; the last representatives, as far as we know,

appear in the upper Jura of Stramberg, where a considerable number of different forms are found.

The genus *Æcotraustes* was created for species of the group of *O. genicularis*, Waagen; Neumayria for such species as *O. trachynotus* and *O. Hauffiana*, of Oppel.

HAPLOCERAS, Zittell, 1870.

Syn.—*Lissoceras* and *Puzosia*, Bayle, 1878.

Distr.—76 sp. Jurassic, Cretaceous. *H. ligatum*, d'Orb. (xxxiv, 49, 50).

Established for a group allied to *Oppelia* from the middle and upper jurassic, which is characterized by very feeble or no sculpture; also some cretaceous forms, as *Hapl. Grusanum*, are placed here; and with them forms very pronounced wedge- or chisel-shaped in section, as *Hapl. belus*; finally, species with quite sharp external sides, as *Hapl. nisus*, Orb.

In other jurassic species of *Haploceras*, there is gradually developed a transverse sculpture, which is confined to the external side of the body-chamber (*Hapl. jungens*, Neum., *carachtheis*, Zeuschner).

In certain upper jurassic forms, which are allied to *Hapl. carachtheis*, the sculpture gradually passes from the external side over to the flanks in feebly undulating ribs, as is shown in *Hapl. cristiferum*, Zitt.; better developed in *Hapl. wöhleri*, Opp.; and this feature is repeated in *Hapl. difficile*, Orb., *Cleon*, Orb., *bicurvatum*, Leym.

Finally, species of *Haploceras* appear which are distributed in the cretaceous, with constrictions reaching forwards (*Hapl. Beudanti*, *Parraudieri*), a peculiarity which does not occur in any jurassic form; the inner whorls here serve as sure guides, aside from the agreement of the lobular markings, since they represent a typical *Haploceras* with entirely smooth whorls. With these furrows a sickle-shaped undulating radial sculpture is gradually combined, and a group of forms results, of which the principal type is *Hapl. planulatum*, Sow.

In spite of this great manifoldness, it is very easy to distinguish the representatives of *Haploceras* from strata which are lower than the turonian and downwards, by their whole habitus and lobes, yet nothing is more difficult to express in words.

This genus corresponds with *Ammonites Ligati* of d'Orb. Bayle changed the name to *Lissoceras*, because *Haploceras* was preoccupied by d'Orbigny; the latter's species is, however, a synonym of *Cyrtoceras*.

Stephanoceratæ.

Form very variable. *Aptychus* calcareous, granular, formed of two plates, which are sometimes joined at the median line. The *Stephanoceratæ* may be subdivided into *normal*, with regular

discoidal, spiral shell, and *evolute*, with discoidal, helicoid or straight shell, the whorls unwound partly or entirely. This evolution is partly generic, but in some instances is known to be accidental: thus specimens of *Acanthoceras angulicostatum*, d'Orb. have the whorls slightly embracing, or merely in contact (*Lytoceras*), or completely detached (*Crioceras*).

a. Normal.

STEPHANOCERAS, Waagen, 1869.

Syn.—*Dactylioceras*, Hyatt, 1867. *Globites*, de Haan, 1825. *Orbulites*, Lam., 1801. *Sphæroceras*, Bayle, 1878.

Distr.—41 Jurassic sp. *S. (Dactylioceras) annulatum*, Sowb. (xxxiv, 47, 48). *S. Blagdeni*, Sowb. (xxxiv, 57, 59).

General form of the shell very variable, external side rounded without keel, angle or furrow. Sculpture never sickle-shaped, decorated with straight, bifurcating ribs, abundantly provided with nodes or swellings. Margin of aperture simple or with ears mostly formed of a broad, smooth zone; aperture frequently constricted. Body-chamber one to one and one-quarter whorls long. Lobes usually deeply divided, siphonal and upper lateral lobe usually of the same length; a stout auxiliary sutural lobe; lobular bodies narrow. Aptychus divided, calcareous, very thin, covered with granules on the external surface.

Stephanoceras diverges from *Ægoceras* with *Steph. pettos* in the middle Lias; according to the subdivision into groups, it embraces the Liassic *Planulata*, *Coronata* and *Bullata* after the exclusion of some heterogeneous elements; the last representatives come from the Oxfordian (*Steph. Collini*, Opp., *glomus*, Opp.).

CADOCERAS, Fischer, 1882. Shell much swollen; umbilicus narrow, carinated; last whorl entirely smooth, preceding whorls with ribs forming an angle directed forwards in the ventral region. *S. modiolare*, Luid.

PROTOPHYTES, Ebray, 1860. Last whorl geniculated, embracing; umbilicus transverse, linear; ribs interrupted at the periphery; aperture with a peripheral appendage, triangular, wide and thick. *S. Oxfordianum*, Ebray.

ŒCOPTYCHIUS, Neumayr, 1878. Last whorl geniculated, embracing; lateral ear-like projections short and narrow; a cowl-like ventral appendage. *Œ. refractus*, de Haan.

MORPHOCERAS, Douvillé, 1880. Whorls rounded with radiating ribs uniting in groups of one to three near the umbilicus, which is scalariform in the juvenile, and much widened in the adult; aperture geniculated, almost completely closed by the expansion of the lateral ears, which unite at the median line on one side and on the other touch the preceding whorl; thus there are, so to say, five apertures, the peripheral, two small ones, placed each

side of the peripheral, two half-round ones limited partly by the preceding whorl. *S. pseudo-anceps*, Ebray.

CÆLOCERAS, Hyatt, 1867.

Distr.—*C. centaurus*, d'Orb. (xxxvi, 87, 88). Middle and Upper Lias.

Pilæ on the periphery bifurcated; lateral pilæ single or bifurcated with one external row of tubercles, occurring regularly on each, or at intervals on widely separated pilæ. The young are very much flatter than the adults, and the sides consequently very narrow. They are smooth for the first one or two whorls, subsequently becoming tuberculated. The tubercles almost immediately spread, forming the pilæ; they may enlarge and remain distinct, or become absorbed and disappear upon alternate pilæ. The abdomen remains perfectly smooth for some time after the lateral pilæ are developed, not acquiring the abdominal pilæ until the third whorl is reached. Septa close together and very intricate in the adult. Abdominal lobe broader and deeper than the superior lateral. The inferior lateral is nearly the same in size, and both are unequally divided into three shallow, minor lobes. Superior lateral cell lobiform and together with the inferior lateral, unequally divided by two minor lobes.

COSMOCERAS, Waagen, 1869.

Syn.—Parkinsonia, Bayle, 1878.

Distr.—42 sp. Jurassic. *C. Calloviense*, d'Orb. (xl, 46, 47).

Siphonal side (periphery) mostly with a smooth furrow; sculpture consisting mostly of dividing ribs, directed forwards at the periphery, frequently ornamented with nodes or swellings; margin of aperture in the young state frequently with ears, which are lost by age; body-chamber one-half whorl long. Lobes moderately divided; siphonal lobe distinctly shorter than the first lateral; second lateral repeating the form of the first; one or more auxiliaries. Aptychus apparently as in *Stephanoceras*.

PERISPINCTES, Waagen, 1860.

Syn.—Ellipsolithes, Montf., 1808. Planulites, Montf., 1808. Pictonia, Bayle, 1878.

Distr.—161 sp. Jurassic, Cretaceous. *Perispinctes arbutigerus*, d'Orb. (xli, 60, 61).

Shell mostly with wide umbilicus, with rounded external side, sculpture consisting mostly of straight, undivided, not nodose ribs; margin of aperture simple or with ears, with a constriction; also isolated constrictions on the inner whorls. Length of body-chamber two-thirds to one whorl, mostly scarcely embracing one circumference or turn. Lobular line similar to *Stephano-*

ceras, usually somewhat more deeply notched, with a dependent sutural lobe. Aptychus divided, calcareous, very thin, externally granular.

This group corresponds to the Planulati of Buch.

SIMOCERAS, Zittel.

Distr.—26 sp. Jurassic. *S. Jooraensis*, Waagen (xli, 66, 67).

Shell very flat, discoidal, umbilicus wide, with numerous whorls, which increase in thickness very slowly (except in the geologically oldest forms); external side rounded or grooved; sculpture seldom absent, consisting mostly of straight, simple or forked ribs, which are interrupted during most of the lifetime of the animal; interrupted at any rate in the young state on the external side, and which are often ornamented with tubercles or strongly swollen on the last whorl; isolated constrictions directed forwards on all the whorls. Body-chamber long, at least three-quarters of a whorl, usually attaining a greater length. Lobular line not very complicated. Siphonal lobe largest, external saddle much developed and broad, laterals one-pointed, very small in the geologically younger forms. Aptychus (?).

REINECKEIA, Bayle, 1878. Shell close to Perisphinctes, but with more marked constrictions, and a peripheral groove. *S. anceps*, Reinecke.

PELTOCERAS, Waagen, 1871.

Distr.—13 sp. Jurassic; Europe, India. *P. Arduennense*, d'Orb. (xli, 64, 65).

Shell when young having the ornamentation of Perisphinctes; when adult, with straight tuberculated ribs; aperture with persistent lateral projections.

ASPIDOCERAS, Zittel, 1866.

Syn.—Waagenia, Neumayr, 1878.

Distr.—48 sp. Jurassic, Cretaceous. *A. longispinum*, Sowb. (xxxiv, 56, 58).

External form very variable, sometimes flat with wide umbilicus, sometimes inflated with a narrow umbilicus; external side rounded or with a broad external furrow, never with a carina or angle. Sculpture consisting of one or two rows of tubercles or wanting. Ribs, as a rule, present only in the young state. Margin of aperture simple (*Asp. aporum* with ears?), body-chamber short, embracing two-thirds of a whorl. Lobular line tolerably simple; siphonal, two laterals, also often (in the geologically younger species) an auxiliary lobe. Lobes not much cut (with the exception of *Asp. Altenense* and *circumspinosum*); bodies of the lobes and saddles broad. Cellulose aptychi.

Aspidoceras reaches the highest point of its development in the Kimmeridgian, and dies out in the Neocomian.

ACANTHOCERAS, Neumayr, 1875.

Distr.—36 sp. *A. Rotomagense*, Brong. (xxxv, 70).

Shell with a moderately wide umbilicus and not very elevated whorls. Margin of aperture and length of body-chamber unknown. The sculpture consists of quite straight ribs, which become constantly stronger from the suture outwards to the external side, which are frequently ornamented with a greater or less number of tubercles or nodes, and are most curved in young individuals. The development of the external side is very variable, the middle line sometimes with uninterrupted ribs, sometimes with a furrow, sometimes with a line of tubercles, the elements of which attempt to unite into a keel. Lobular line much reduced; besides the two laterals on the flanks there is at most one auxiliary, or a row of two to three extremely small deep-lying auxiliaries; bodies of the lobes and saddles plump and broad, the last broader than the first, no branching, but only a dentation of the lobes. Siphonal and first lateral usually not very different in size, the first often larger than the last; second lateral much smaller than the first, both one-pointed.

STOLICZKAIA, Neumayr, 1875.

Dedicated to Dr. Stoliczka, of the Geological Survey of India.

Distr.—8 sp. Cretaceous; India. *S. dispar*, Stol. (xli, 62, 63).

Forms allied to *Hoplites dutempleanus*, with expanded body-chamber, embracing three-fourths (?) of a whorl. Margins of aperture curved, produced at the middle of the flanks, slightly emarginate at the external side. Inner whorls with radial ribs which are not interrupted on the external side, and usually here attain their maximum strength; body-chamber smooth or with thickened ribs; external side without keel or furrow. Lobular line branched, consisting of a siphonal, two lateral, and one or more less dependent sutural lobes.

HOPLITES, Neum., 1875.

Syn.—Sonneratia, Bayle, 1878.

Distr.—50 sp. Cretaceous. *H. Archiacianus*, d'Orb. (xli, 68, 69).

Derived from the group of forms represented by *Perisphinctes involutus*, with moderately narrow umbilicus and high whorls; thickness very variable. Margin of aperture and length of body-chamber unknown. Sculpture consisting of divided and curved ribs, which originate near the umbilicus or in the middle of the flanks in small, thickened, primary ribs or a tubercle; ribs interrupted on the periphery, often separated by a deep furrow, or at least feebler at this point; ribs enlarged at both extremities, weaker at the middle of the flanks. Lobular line complicated, with branches and numerous auxiliaries; lobular bodies not very plump; saddles as wide or (mostly) wider than

the lobes. First lateral always longer than the siphonal lobe; second lateral strikingly short; auxiliary horizontal or very slightly depending.

OLCOSTEPHANUS, Neumayr, 1875.

Distr.—33 sp. Jurassic to Cretaceous; Europe, India. *O. Bhawani*, Stol. (xl, 53, 54).

Body-chamber only about one-third of the last whorl; surface ornamented by ribs which are interrupted at the rounded periphery; aperture simple or eared, contracted; most of the species are distantly constricted; sutural line complicated by the presence of three auxiliary lobes.

b. Evolute.

SCAPHITES, Parkinson, 1811.

Etym.—*Scaphe*, a boat.

Distr.—34 sp. Cretaceous; Europe, America. *S. æqualis*, Sowb. (xxxii, 35). Sussex, England.

Shell at first closely spiral, involute, at length detached and recurved; sutures many-lobed, lobes foliated.

The Scaphites (with the exclusion of *Sc. Yvanii*) form a very good natural group, very distinctly characterized by the involute spiral of the chambered portion of the tube, to which but one very short evolute hook is attached, by their aptychus, which by its form, its want of strong longitudinal sculpture, and the surface covered with granules, is allied to the aptychi of Perisphinctes, and by the appearance of auxiliary lobes, which are wanting in all other evolute forms. The form of the aptychus decidedly indicates that they are serially to be connected with the Perisphinctes-stem, and the form of the inner whorls of the geologically old species, which agree entirely in form with *Olc. Guastaldinus*, indicates strongly their connection with *Olcostephanus*, which is also confirmed by the form of the aperture.

DISCOSCAPHITES, Meek, 1876. For forms, the ornamentation of which recalls that of *Acanthoceras*. *S. Cheyennensis*, Owen; *S. Conradi*, Morton.

HAMITES, Parkinson, 1811.

Etym.—*Hamus*, a hook. *Syn.*—*Ammonoceras*, Lam., 1822.

Distr.—150 sp. Cretaceous. *H. attenuatus*, Sowb. (xxxiii, 40). *H. cylindraceus*, DeFr. (xxxiii, 41).

Shell with the tube unrolled, and variable in ornamentation; sutural line rather simple; a siphonal lobe, two lateral lobes divided into pairs—sometimes symmetrical, sometimes asymmetrical in the second lobe; rarely with auxiliary lobes. Aptychus(?).

Hamites may include all the unwhorled Ammonitæ of the

Cretaceous, with the exception of Scaphites, Turrilites and Baculites. Neumayr has divided them into two groups: Hamites, applying to the species approaching *Lytoceras* by their ornamentation, and their sutural line having lobes symmetrically divided into pairs; Crioceras, containing the forms having the ornamentation of *Acanthoceras*, with lobes not symmetrically divided. Fischer arranges them in the following subgenera or sections, some of which are considered genera by other systematists:

MACROSCAPHITES, Meek, 1876. Shell with inner turns merely in contact, or so slightly embracing as to leave a very large, shallow umbilicus; periphery rounded; body portion much extended from the inner volutions; surface costate. *S. gigas*, Sowb.

ANCYLOCERAS, d'Orb., 1842. Shell at first spiral, discoidal with separated whorls; afterwards produced at a tangent and then bent back again upon itself like a hook. 41 sp. Infer. Oolitic, Cretaceous; Europe, South America, United States. *H. spinigerus*, Sowb. (xxxii, 33). Gault, Folkestone.

ANISOCERAS, Pictet, 1854. Shell at first spiral, helicoid, whorls separated, at length more or less prolonged and reflected; transversely ribbed; sutures of septa with five lobes and saddles, all bipartite. 12 sp. Gault to Upper Greensand; Europe. Cretaceous, Jurassic; India. *H. Saussureanus*, Pictet (xxxii, 34).

HAMITES, Parkinson (restricted). Shell conical, hook-shaped, bent upon itself more than once, the courses separate. 38 sp. Chalk; Europe, S. America.

HAMULINA, d'Orb., 1849. Differs from Hamites in being only once bent upon itself, not in contact. 20 sp. Neocomian; France. Gault (?); India. *H. trinodosa*, d'Orb. (xxxiii, 42).

PTYCHOCERAS, d'Orb., 1840. Shell bent once upon itself; the two straight portions in contact. 8 sp. Neocomian to Cretaceous; Europe, India, United States. *H. Emericianus*, d'Orb. (xxxiii, 43). France.

DIPTYCHOCERAS, Gabb, 1869. Three straight limbs in contact. A Ptychoceras in every respect except that it has an additional limb which incurves, enveloping both the preceding to a slight degree only. Meek considers it doubtfully identical with Ptychoceras.

TOXOCERAS, d'Orb., 1840. (*Taxon*, a bow, *ceras*, a horn.) Shell horn-shaped or curved; the six lobes and saddles of the sutures simply crenulated; last chamber large. Connected with Crioceras and Ancyloceras by numerous intermediate forms. 20 sp. Neocomian; France. *H. bituberculatus*, d'Orb. (xxxii, 32).

CRIOCERAS, Leveillé, 1836. Shell discoidal, whorls not contiguous, but in the same plane. 13 sp. Neocomian to U. Greensand; Europe. Some of the species are believed to be merely

incomplete Ancyloceræ. *H. cristatus*, d'Orb. (xxxii, 29). Gault; Southern France.

TURRILITES, Lam., 1801.

Etym.—*Turris*, a tower, *lithos*, a stone.

Distr.—37 sp. Gault to Chalk; Europe. *T. costatus*, d'Orb. (xxxiii, 37). *T. Boblayi*, d'Orb. (xxxiii, 38).

Shell spiral, depressed to elongate, sinistral; sutures six-lobed, foliated; aperture often irregular.

The animal of Turrilites was perhaps dibranchiate by the atrophy of the respiratory organs of one side.

HETEROCERAS, d'Orb., 1847. Shell like Turrilites, but last chamber somewhat produced and recurved. 5 sp. Cretaceous; Europe, United States. *T. Emericii*, d'Orb. (xxxiii, 39).

HELICANCYLOCERAS, Gabb, 1869. Spire less elevated, volutions less decidedly in contact.

HELICOCERAS, d'Orb., 1842. (*Helix* [*helicos*], a spiral, *ceras*, a horn.) Shell spiral, sinistral; whorls separate; annular costæ passing uninterruptedly over the siphonal side. 11 sp. Inferior Oolitic (?) to Cretaceous; Europe, India, United States.

PATOCERAS, Meek, 1876. Costæ interrupted on the siphonal side, leaving a narrow, smooth space along the whole length of the same. *T. Teilleuxii*, d'Orb. (xxxiii, 36). Jurassic.

BACULITES, Lam., 1801.

Etym.—*Baculus*, a staff. *Syn.*—Cyclomera, Conrad, 1866.

Distr.—20 sp. Cretaceous; Europe, Chili, India, United States. *B. anceps*, Lam. (xxxii, 30). France. *B. baculoides*, d'Orb. (xxxii, 31).

Shell straight, elongated, conical; suture foliately lobed; last chamber large; margin of aperture dorsally produced.

The baculite limestone of Normandy is so called from the numerous remains of the shells of this animal which it contains.

Conrad has given the name Cycloceras to a Baculite figured by him, but without generic characters; afterwards, finding that name preoccupied by M'Coy, he changed it to Cyclomera, still giving no diagnosis.

Meek divides Baculites into two subgeneric forms, which, he remarks, are possibly distinct genera.

BACULITES, Lam. (typical). *a.* Shell straight throughout; aperture directed forward; lip with lateral sinuses directed backward; the projection of its siphonal margin, straight, and its anti-siphonal margin convex in outline; interior without regularly disposed ridges. *B. vertebralis*, Lam.

(?) *b.* Shell straight posteriorly, but with the non-septate part gently arcuate; aperture a little oblique; appendage of siphonal side of lip arching slightly with the general curvature of the non-

septate part, but not curving over the aperture. *B. incurvatus*, Dujardin.

CYRTOCHILUS, Meek, 1876. Shell straight; aperture opening towards the antisiphonal side, and the lateral sinuses of the lip excavated in the opposite direction; projection of siphonal margin of lip abruptly arching over the aperture, and the antisiphonal margin of same deeply sinuous instead of convex in outline; interior with regularly disposed ridges, leaving oblique constrictions on internal casts. *Hamites baculoides*, Mantell = *B. obliquatus*, Sowb.

BACULINA, d'Orb., 1847.

Distr.—2 sp. Jurassic, Lower Chalk; Europe. *B. arcuaria*, Quenstedt (xxxii, 24).

Shell straight, point conical; sutures of septa a row of rounded lobes, toothed at base.

CLASS PTEROPODA.

Mollusk naked, or protected by an external or internal, testaceous or membranaceous shell of variable form, with or without operculum. They are essentially pelagic, furnished with a foot dilated on each side into a large aliform expansion suitable for swimming; or having only a rudimentary foot, but with accessory locomotive organs, represented by two lateral swimming disks. In swimming the body is nearly reversed in position, the abdomen being uppermost. The more or less distinct head has one or two pairs of tentacles. Mouth terminal or subterminal, with lingual armature, and sometimes organs of prehension and of mastication. Branchiæ, either external or contained within an interior cavity. The sexes are united in the same individuals, but the male organ is separated from the female. Carnivorous.

The pteropods are all small mollusks, some of them even microscopic; they are commonly known as sea-butterflies and whale-food. The first of these names has been given on account of the form and incessant movement of their swimming lobes; the second because they form a portion of the food of the *Balæna* and other cetaceans, as well as of a great number of fishes. The pteropods live at a certain depth beneath the surface, and only approach shores by accident, or when carried by storm or current.

The *Pneumodermon*, *Clio* and large species of *Cleodora* usually appear at night only, and some only when the night is very dark; and d'Orbigny supposed that it is only when the degree of obscurity at the surface approximates to that which the animal habitually perceives in its daylight habitation, that it rises at all; certain it is, says he, that so soon as the sun appears, not a pteropod is to be seen. Later observers, however, have established the fact that specimens may be obtained from the surface of the ocean at all hours of the day, although they are mainly crepuscular in habit.

These little animals are eminently sociable, forming considerable masses in the regions which they inhabit. They occur in all seas, but most of them are found in temperate and tropical latitudes, whilst a few forms are restricted to the Arctic seas. Contrary to the usual fact among mollusca, the Arctic species are here the most highly colored; due to the transparency of their shell, which partly shows the viscera.

Pteropods live upon microscopic animals, and possibly small mollusks, such as *Atlanta* and crustaceans. A few of them possess organs of prehension, but it is difficult to indicate the means by which the most of them seize their prey.

Among the pteropods some have an external or internal shell

which is either testaceous or membranaceous, whilst others are naked. They all possess a heart, composed of auricle and ventricle, within a pericardium. Their organs of sense are very restricted: they have no eyes; at least the little black points formerly considered visual organs, M. Souleyet has ascertained to be hearing pouches, having no exterior opening. The mouth is more or less developed and is furnished with a lingual ribbon, and the olfactory organ has its seat in the tentacles.

The *Cavolina tridentata* oviposits at sunset. Its eggs are enveloped in a very smooth and elastic glairy ribbon, presenting a series of pouch-like enlargements. The Thecosomoid species, *Cymbulia Peronii*, lays its eggs at any hour of the day: they are enveloped in a glairy cylindrical mass, containing a few partitions or chambers, each of which may include forty eggs; several of these masses may be laid during a day, and the whole will amount to about twelve hundred eggs.—FOL, *Archives Zool. Exp.*, iv, 1875.

The larval pteropods are furnished with a velum, which disappears a short time after the appearance of the adult swimming organs. In the earlier phases of their development a shell always exists; even in those genera in which the adult is naked, *i. e.* without shell.

The Pteropoda are considered by some naturalists as a subordinate group of the Gastropoda, and they are certainly much more closely allied to the latter than to the Cephalopoda; but their pelagic habit and organization appear to indicate a distinct class. Their geological record does not sustain the views of those who look upon them as gastropods arrested in development, for the type occurs in the primordial fauna; moreover, they have a temporary velum, so that the wings do not represent that organ of the Gastropoda.

ORDER THECOSOMATA.

Etym.—*Theke*, a case, *soma*, a body.

Animal furnished with an external shell, which is sometimes cartilaginous; head indistinct; foot and tentacles rudimentary, combined with the fins; mouth situated in a cavity formed by the union of the locomotive organs; respiratory organ contained within a mantle cavity, either dorsal or ventral.

FAMILY HYALEIDÆ.

Shell straight or curved, never spiral, globular or needle-shaped, symmetrical. No operculum.

Animal with two large fins, attached by a columellar muscle passing from the apex of the shell to the base of the fins; body enclosed in a mantle; gill represented by a transversely plaited

and ciliated surface, within the mantle cavity, on the ventral side; lingual teeth (of *Hyalea*) 1·1·1, each with a strong recurved hook (xii, 55).

HYALEA, Lamarck, 1799.

Etym.—*Hyalëos*, glassy.

Syn.—Cavolina, Gioeni (not Brug.), 1783.

Distr.—19 sp. Atlantic, Mediterranean, Indian Ocean. *H. tridentata*, Gmel. (xlii, 1). *H. quadridentata*, Les. (xlii, 2). Fossil, 10 sp. Miocene; Sicily, Turin, Dax, Azores.

Shell globular, translucent; dorsal plate rather flat, produced into a hood; aperture contracted, with a slit on each side; posterior extremity tridentate.

Animal with long appendages to the mantle, passing through the lateral slits of the shell; tentacles indistinct; fins united by a semicircular ventral lobe, the equivalent of the posterior element of the foot.

The long, loose, lateral, pallial prolongations, which the testaceous pteropods protrude from the lateral fissures of the shell, do not appear to be of much use in guiding or propelling, which functions are performed by the wide alar expansions. They may assist, however, in extending the surface of the mantle for the purpose of aëration.—A. ADAMS, *Narr. Voy. Samarang*, ii, 522.

GAMOPLEURA, Bellardi, 1881. Shell laterally impervious. *H. Taurinensis*, Sismonda. Tertiary; Piedmont.

DIACRIA, Gray, 1840. (Pleuropus, Esch., 1825.) *H. tri-spinosa*, Less. (xlii, 7, 8.) Shell tricuspidate, the terminal point long; with lateral slits opening into the cervical aperture.

CLEODORA, Peron and Lesueur, 1810.

Syn.—Clio, Linn. (part), Browne, not Müller.

Distr.—12 sp. Atlantic, Mediterranean, Indian Ocean, Pacific, Cape Horn. *C. compressa*, Eyd. (xlii, 3). Fossil, 4 sp. Miocene—; Britain. *C. infundibulum*, Crag.

Shell pyramidal, three-sided, striated transversely; ventral side flat, dorsal keeled; aperture simple, triangular, with the angles produced; apex acute.

Animal with tentacles obsolete; mantle processes short or absent; fins ample, bilobed, united ventrally by a rounded lobe; lingual teeth 1·1·1. The transverse bars of the gills, the heart, and other organs are visible through the pellucid shell.

BALANTIUM (Leach), Gray, 1847. Shell triangular, depressed, transversely undulated; mouth oblong, oblique, narrow. Animal similar to Cleodora. *B. recurvum*, one of the handsomest of the pteropods, swims steadily, instead of flitting about in the lively manner of the Hyalæa. *C. inflata*, Eyd. (xlii, 4, 5).

FLABELLULUM, Bellardi, 1871. Shell transversely undulated

and rugose; dorsal surface longitudinally ribbed; lateral margins rectilinear. 3 sp. Miocene; northern Italy.

POCULINA, Bellardi, 1871. Surface not transversely undulated; lateral margins slightly convex. 3 sp. Miocene; northern Italy.

EUCHILOTHECA, Fischer, 1882.

Distr.—*Cleodora Parisiensis*, Desh. Eocene; Paris.

Shell narrow, conically subulate, apex subinflated, ovoid, mucronate, not septate within; aperture ovate, horizontal, not oblique, margin externally reflected, sometimes bilabiate.

HYALOCYLIX, Fol., 1875.

Distr.—*H. (Cleodora) striata*, Rang. Mediterranean, Atlantic.

Shell conic, slightly depressed, transversely grooved; aperture oval, not oblique; summit acuminate. Animal with bilobed wings.

STYLIOLA, Lesueur, 1826.

Syn.—Creseis, Rang, 1828.

Distr.—6 sp. *S. subulata*, Quoy (xlii, 6).

Slender, conical, pointed, straight, or curved. Fins rather narrow, truncate, with small tentacles projecting from their dorsal edges, and rudiments of the mesopodium on their surface; mantle-margin with a spiral process on the left side. M. Rang states that he has seen these pteropods clustering round floating seaweed.

Mr. Arthur Adams has observed them, during a calm in the Atlantic towards the decline of day, shining near the surface like myriads of glassy spicula; they often remain posed and motionless, and their progression through the water is very irregular.

Barrande has seen a triangular operculum in connection with *H. striatus*, as well as similar bodies with other species.

CUVIERIA, Rang, 1827.

Dedicated to Baron Cuvier.

Distr.—4 sp. Atlantic, India, Australia. *C. columella*, Rang (xlii, 9). Fossil, 4 sp. Miocene and Pliocene; Turin, Calabria.

Shell cylindrical, transparent; aperture simple, transversely ovate; apex acute in the young, afterwards partitioned off, and usually deciduous, so that the end of the shell is blunt or truncate.

Animal with simple narrow fins, united ventrally by two small lobes; lingual teeth 1·1·1.

VAGINELLA, Daud, 1802. Shell oblong, with a pointed apex; aperture contracted, transverse. Fossil, 4 sp. Miocene; Bordeaux, Turin. *C. depressa*, Daud (xlii, 32).

The genus Triptera, Quoy and Gaimard, 1824, was founded on a fragment of a Cuvieria.

HYOLITHES, Eichw., 1840.

Syn.—Theca, Morris, 1845. Pugiunculus, Barrande, 1847. Cleidotheca and Centrotheca, Salter, 1866.

Distr.—Fossil, 40 sp. Palæozoic; North America, Europe, N. S. Wales. *H. fasciculatus* (xlii, 11).

Shell straight, conical, tapering to a point, back flattened, aperture trigonal. Length, 1–8 inches.

HYOLITHELLUS, Billings. Differs from Hyolithes in its long, slender form and in the peculiar structure of the operculum. *H. micans*, Billings (xlii, 12). Palæozoic; N. America. It may be a Salterella. *a* represents the rate of tapering of the shell on its ventral side, and the included figure its apical portion; *b* is the inner surface of the operculum, enlarged 2–1, showing radiating muscular impressions.

CLATHROCELIA, Hall, 1879. Shell thinner than Hyolithes, interior cancellated by longitudinal striæ crossing the arcuated septal lines. *H. Eborica*, Hall. Devonian; U. S.

PTEROTHECA, Salter, 1852.

Syn.—Clioderma, Hall, 1861.

Distr.—*P. transversa*, Portlock. 8 sp. Silurian; Ireland, Wales, Canada, Bohemia.

Shell bilobed, transversely oval, with a dorsal keel projecting slightly at each end; ventral plate small, triangular.

CYRTOTHECA, Hicks. Shell with curved apex; a longitudinal ridge extends along the surface of the sides near the centre; but the surface is otherwise tolerably smooth; mouth funnel-shaped with one lip greatly elongated. *P. hamula*, Hicks (xlii, 13). Cambrian; Gt. Britain.

STENOTHECA, Hicks. Curved, wide, with the lines of growth strongly marked on the surface. *P. Cornucopiæ*, Hicks (xlii, 14). Cambrian; Gt. Britain.

SCENELLA, Billings. Has a smoother surface. Palæozoic; Newfoundland.

PHRAGMOTHECA, Barrande, 1867.

Distr.—*P. Bohemica*, Barrande. Upper Silurian; Bohemia.

Shell like that of Pterotheca, but having septa. Differs from the cephalopods, which are chambered, in the want of a siphuncle.

CONULARIA (Miller), Sowerby, 1818.

Etym.—*Conulus*, a little cone. *Syn.*—Conulites, Schloth.

Distr.—Fossil, about 100 sp. Silurian to Carb.; N. America, Europe, Australia. *C. Geroldsteinensis* (xlii, 15).

Shell four-sided, straight, and tapering, the angles grooved, sides striated transversely, apex partitioned off. The Conulariæ were the giants of the Pteropoda; *C. inornata*, Dana, of Australia, is supposed to have been 16 inches long.

COLEOPRION, Sandberger. Shell round, tapering, sides obliquely striated, striæ alternating along the dorsal line. *C. gracilis*, Sandb. Devon.; Germany.

COLEOLUS, Hall, 1879. Shell tubuliform, straight or slightly curved, rather thick, smooth within; surface more or less obliquely grooved, and sometimes longitudinally striate. *C. aciculus*, Hall. Devonian; U. S.

HERMICERATITES, Eichwald, 1840.

Distr.—Fossil, 3 sp. Middle Silurian; Russia.

Shell cylindrical or semicylindrical, elongated, straight, with a dark brown corneous epidermis, furnished with a straight, median siphuncle, which does not traverse any chambers.

Very doubtful pteropods; might as well be referred to Cephalopoda.

SALTERELLA, Billings, 1861.

Dedicated to Mr. J. W. Salter, late Palæontologist to the Geological Survey of Great Britain.

Distr.—Fossil, 3 sp. Lower Silurian; Canada.

Shell small, slender, conical, straight, consisting of many cones placed one within the other; the transverse section of the tubes is circular or subtriangular; the surface is transversely or longitudinally striated. This is very probably an Annelid; as is also Tentaculites, Schloth.

FAMILY CYMBULIIDÆ.

Animal oval, with large rounded wings. Dentition 1·1·1; the central tooth very large, the laterals wide at the base, unicuspid.

Shell symmetrical, subinternal, cartilaginous, slipper-like. Embryos with a caducous, operculated, testaceous, spiral shell.

CYMBULIA, Peron and Lesueur, 1810.

Etym.—Diminutive of *cymba*, a boat.

Distr.—3 sp. Atlantic, Mediterranean, Indian Ocean. *C. proboscidea*, Peron (xlii, 17).

Shell cartilaginous, slipper-shaped, spinous, pointed in front, truncated posteriorly; aperture elongated, ventral.

Animal with large rounded fins connected ventrally by an elongated lobe; mouth furnished with minute tentacles; stomach muscular, armed with two sharp plates.

TIEDEMANNIA, Chiaje, 1839.

Named after Fr. Tiedemann. *Syn.*—Gleba, Forskal.

Distr.—3 sp. Mediterranean, Australia. *T. Neapolitana*, Chiaje (xlii, 18).

Animal naked, transparent, fins united, forming a large rounded

disk; mouth central; tentacles elongated, connate; eye-tubercles minute. Larva shell-bearing.

COROLLA, Dall, 1871. Like Tiedemannia, but with the body pendant below, unattached to the pinnæ, ovoid, constricted above; œsophagus produced, aperture trumpet-shaped, produced into two points; pinnæ forming a single disk with reticulated muscular bands, separated by a deep sinus from the oral portion. No shell. *T. spectabilis*, Dall. N. Pacific Ocean.

FAMILY LIMACINIDÆ.

Shell minute, spiral, sinistral, calcareous. Operculum paucispiral, vitreous.

Animal with fins attached to the sides of the mouth, and united ventrally by an operculigerous lobe; mantle-cavity large, opening dorsally; excretory orifices on the right side.

The shells of the true Limacinidæ are sinistral, by which they may be known from the fry of Atlanta, Carinaria, and most other gastropods.

LIMACINA, Cuvier, 1817.

Etym.—*Limacina*, snail-like. *Syn.*—Spiratella, Bl., 1824.

Distr.—2 sp. Arctic and Antarctic Seas; gregarious. *L. Antarctica*, Forbes (xlii, 20).

Shell subglobose, sinistrally spiral, umbilicated; whorls transversely striated; umbilicus margined.

Animal with expanded fins, notched on their ventral margins.

VALVATELLA, Mörch, 1874.

Syn.—Planorbella, Gabb, 1872 (not Haldeman).

Distr.—Tertiary; Sicily, Denmark, West Indies. *V. atlanta*, Mörch. *P. imitans*, Gabb.

Shell minute, vitreous, sinistral, apex sunken as in Planorbis. The type, a West Indian fossil, might be taken for a young specimen of *Planorbis trivolvus* were it not sinistral.

SPIRIALIS, Eydoux and Souleyet, 1840.

Syn.—Heterofusus, Fleming, 1825. Heliconoides, d'Orb. Peracle, Forbes. Scæa, Ph., 1844.

Distr.—12 sp. Greenland and Norway to Cape Horn, Indian Ocean, Pacific. *S. ventricosa*, Eyd. (xlii, 21). Fossil. Eocene; Paris basin. Pliocene; Sicily, Rhodes.

Shell minute, hyaline, sinistrally spiral, globose or turreted, imperforate or narrowly perforated, smooth or reticulated; operculum thin, glassy, semilunar, slightly spiral, with a central muscular scar.

Animal with narrow, simple fins, united by a simple, transverse operculigerous lobe; mouth central, with prominent lips.

The pteropods are infrequent visitors to our coasts; *Spirialis Flemingii*, however, occurred at Nahant, Mass., in great abundance during the summer of 1863. Mr. Alexander Agassiz gives the following account of its habits:

They come to the surface of the water about an hour after dusk; they do not remain long, and after ten o'clock at night were rarely met with. He succeeded only once in finding a few isolated specimens during the heat of the day; while at full tide, soon after dark, they were very often found in abundance. These animals are very easily kept in captivity, and their habits, which can then be carefully watched, may explain in a very satisfactory manner their sudden appearance and disappearance. They creep about by means of their wing-like appendages. They but rarely left the bottom during the day, merely rising a few inches, and then falling down again to the bottom of the jar. After dark, however, they could all be seen in great activity, moving near the surface of the water as fast as their appendages enabled them. During the day, they often remain suspended for hours in the water, simply by spreading their wing-like appendages, and then suddenly drop to the bottom on folding them. When the animal is in motion, beating the water like a butterfly to propel itself forwards or upwards, the shell is carried at right-angles, hanging somewhat obliquely to the direction of the movement.—*Bost. Proc.*, x, 14.

HELICONOIDES, d'Orb., 1839. (Protomedea, Costa, 1861. Embolus, Jeffreys, 1869.) Shell thin, transparent, discoidal, sinistral, axis umbilicated; whorls smooth; peristome disunited, notched on each side, and with an elongated, arched beak in front. *S. inflata*, d'Orb. (xlii, 22).

EUROMUS, H. and A. Ad., 1858. Shell oblong, not turreted, cancellated; spire short, obtuse, last whorl swollen, much larger than the others; aperture large, elongate. *S. clathrata*, Eyd. (xlii, 23).

PERACLE, Forbes, 1844. Shell oblong, not turriculated, spire rather short, aperture prolonged into a long, curved canal. 2 sp. European seas. *S. physoides*, Forbes.

AGADINA, Gould, 1852.

Distr.—*A. cucullata*, Gld. (xlii, 24).

Shell colorless, pellucid, planorbular, one side showing five or six whorls, the other a single volution with a large umbilical pit; aperture oblique, campanulate, and projecting beyond the last whorl like a hood.

The single species was found floating near an iceberg in 60° S. latitude and 106° 20' E. longitude. The animal is black, with oval appendages, not lobed.

ORDER GYMNOSOMATA.

Animal naked, without mantle or shell; head distinct; fins attached to the sides of the neck, without intermediate lobe; gills indistinct (*Clio*), or distinct (*Pneumodermon*); teeth numerous.

The embryos are at first Thecosomous, having a straight shell, ovoid at the extremity; they swim by means of a ciliated velum; subsequently, they lose the shell, and the body is encircled by rings of ciliæ (xx, 53, 55), which in turn disappear as the animal assumes its perfect form.

FAMILY CLIIDÆ.

Body fusiform; head with tentacles often supporting suckers; foot small, but distinct, consisting of a central and posterior lobe.

CLIO (L.), Müller, 1776.

Etym.—*Clio*, a sea-nymph. *Syn.*—*Clione*, Pallas, 1774.

Distr.—10 sp. Arctic and Antarctic Seas, Norway, Mediterranean, India.

Head with two eye-tubercles and two simple tentacula; mouth with lateral lobes, each supporting two or three conical retractile processes, furnished with numerous microscopic suckers; fins ovate; foot lobed. Dentition 12·1·12. In swimming, the *Clio* brings the ends of its fins almost in contact, first above and then below (Scoresby).

C. borealis (xlii, 2, 5) is largely the food of whales; the *Clio* and other pelagic animals are attracted to the large bodies of Diatomaceæ which discolor the Arctic seas, and on which they feed. The whale in turn lives upon them, and whalers hail the appearance of these discolored patches of ocean-surface as indicative of a good oil-harvest.

CLIODITA, Quoy and Gaimard. Head supported on a narrow neck; tentacles indistinct. 4 sp. Cape, Amboyna. *C. fusiformis*.

CLIONOPSIS, Troschel.

Distr.—*C. Krohnii*, Trosch. (xlii, 26). Mediterranean Sea.

Body ovate, head keeled, mouth armed with three jaws; two lateral tentacles; fins two, oblong, lateral, anterior, with a truncate intermediate lobe; a ciliated ring around the hinder part of the body.

The ciliated ring around the base of the head, and similar ring around the middle of the body, seen in *Trichocyclos* (*Pneumodermon*), are wanting in this genus.

PNEUMODERMON, Cuvier, 1804.

Etym.—*Pneumon*, lung (or gill), *derma*, skin.

Distr.—4 sp. Atlantic, Indian, Pacific Ocean. *P. Peronii*, Lam. (xlii, 27).

Body fusiform; head furnished with ocular tentacles; lingual teeth 4·0·4; mouth covered by a large hood supporting two small, simple, and two large acetabuliferous tentacles, suckers numerous, pedicillate, neck rather contracted; fins rounded; foot oval, with a pointed posterior lobe; posterior extremity of the body truncate, with small branchial processes, and a minute rudimentary shell (?).

In captivity not shy, but swims actively; when touched folds its fins upon its body and falls to the bottom, rolled up into a little ball.

SPONGIOBRANCHÆA, d'Orb., 1840. Gills forming a spongy ring at the end of the body; tentacles each with six rather large suckers. *Distr.*—1 sp. *P. australis*, d'Orb. (xlii, 28). South Atlantic (Fry of Pneumodermon?). *S. elongata*, d'Orb., is a Clio.

PNEUMODERMOPSIS, Bronn, 1862. Branchiæ at the extremity of the body. *P. ciliatum*, Gegenbauer.

TRICHOCYCLUS, Esch., 1825. Head elongated, trunk-like, with two lateral tentacles; two lateral swimming lobes, and an intermediate lanceolate one; branchiæ in a ciliated ring upon the middle of the body; two similar ciliated rings, one at the base of the head, the other at the truncated posterior extremity of the body. *P. Dumerilii*, Esch. (xlii, 29). Probably larvæ.

(?) PELAGIA, Quoy and Gaimard.

Etym.—*Pelagus*, the deep sea.

Syn.—*Pteropelagia*, Bronn, 1862.

Distr.—*P. alba*, Quoy (xlii, 30). Amboina.

Animal fusiform, truncated in front, rough; head with two tentaculiform tubercles; neck slightly contracted; fins small, fan-shaped.

Supposed by Souleyet to be very close to Clio.

(?) CYMODOCEA, d'Orbigny, 1840.

Etym.—*Kumodoke*, a Nereid.

Distr.—*C. diaphana*, d'Orb. (xlii, 32). Atlantic.

Animal fusiform, truncated in front, pointed behind; neck slightly contracted; fins two on each side, first pair large and rounded, lower pair ligulate; foot elongated; mouth proboscidi-form, four-lobed. The animal is translucent, showing the violet viscera.

CIRRIFER, Pfeffer, 1879.

Distr.—*C. paradoxus*, Pfeffer. Tropical Atlantic.

Body oblong, head distinct; superior tentacles small, anterior tentacles long, bifid and thickened towards the end.

FAMILY EURYBIIDÆ.

Animal short, rounded; head distinct, retractile into a pouch formed by a thickening of the mantle; wings long and narrow. Dentition 1·1·1 according to Macdonald, 1·0·1 according to Souleyet and Huxley.

EURYBIA, Rang, 1827.

Etym.—*Eurybia*, a sea-nymph. *Syn.*—*Theceurybia*, Bronn.

Distr.—4 sp. Atlantic and Pacific. *E. Gaudichaudi*, Eyd. (xlii, 16).

Animal globular; fins narrow, truncated, and notched at the ends, united ventrally by a small lobe (metapodium); mouth with two elongated tentacles, behind which are minute eye-peduncles and a two-lobed rudimentary foot (mesopodium); body enclosed in a cartilaginous integument, with a cleft in front, into which the locomotive organs can be retracted.

The animal has no proper gill, but Mr. Huxley has observed two ciliated circles surrounding the body, as in the larva of *Pneumodermon*.

PSYCHE, Rang, 1825. (*Halopsyche*, Bronn, 1862.) Animal globular, with two simple oval fins, and no tentacles. *P. globulosa*, Souleyet (xlii, 10). Off Newfoundland.

ASPIDELLA, Billings, a very doubtful fossil from the Huronian of Newfoundland, has been referred to the Pteropoda by S. A. Miller in his *Am. Pal. Fossils*. *A. terranova*, Bill. (xlii, 19).

CLASS GASTROPODA.

Head distinct, usually furnished with eyes and tentacles ; body mostly protected by a spiral or conical univalve shell ; lower surface of animal developing a thickened, expanded, creeping disk or foot.

The following subclasses conveniently separate the immense number of molluscan types having the gastropod structure :

Subclass PROSOBRANCHIATA. Sexes separate, in different individuals. Mostly marine animals, provided with a shell and generally, an operculum—at least all operculated mollusks belong to this group. The animal breathes by gills or branchiæ.

Subclass OPISTHOBRANCHIATA. Marine slugs breathing by arborescent or fasciculated branchiæ, which are more or less completely exposed on the back and sides, towards the posterior end (*opisthen*) of the body. A large division of the Opisthobranchiata is shell-less ; another possesses a spiral, conical or lamellar shell, partially concealing the branchiæ, and itself more or less concealed by the mantle-lobes. Sexes united.

Subclass PULMONIFERA. Sexes united in the same individual. Mostly terrestrial (a portion being fluviatile) mollusks, usually provided with a shell, without operculum ; breathing air by the simplest form of lung, a pouch with external opening, lined with a network of respiratory vessels.

The pulmonifera are closely related to the plant-eating sea-snails (holostomata), through *Cyclostoma*, and to the nudibranchs by *Oncidium*. As a group, they are generally inferior to the sea-snails, on account of the comparative imperfection of their senses, and the union of the functions of both sexes in each individual.

SUBCLASS PROSOBRANCHIATA.

The prosobranchiata are typically marine animals, but there are many exceptions to the rule ; for not only do we find a certain number of genera inhabiting brackish water, but some live in fresh water only, and others again are terrestrial. It is not without some modification of the breathing organs that such diversity of station exists, and this modification is coexistent with other adaptations.

Whilst the pulmoniferous mollusks have no operculum, the terrestrial and fluviatile sections of the prosobranchiata are provided with a very efficient one, completely closing the aperture of the shell. The canaliculate aperture, the operculum usually too small to fill this aperture, and, frequently, the want of an operculum are characteristic of the major portion of the proso-

branchiates—the marine zoophaga, whilst the rounded aperture and its efficient operculum belong to the phytophagous groups. In going over the genera of marine prosobranchiates another general law appears to coexist with the foregoing divisions, namely, that the zoophaga are the most active, and are frequently deep-sea animals, whilst the phytophaga are necessarily more confined to shallow water, between tides, etc., where their food is more readily obtainable. Some of the zoophaga prefer a rocky station, whilst others affect sandy or muddy bottoms; the little genus *Stylifer* is parasitic upon echini, etc., immersed in which it dwells, and some other genera habitually seek special stations, as *Pedicularia* and *Magilus* upon corals, certain *Vermetidæ* upon other shells, etc. On the other hand, numerous animals dwell upon and within the substance of the shells of univalve mollusca, including sponges, worms, corals, molluscoids, etc., not to mention many of the true mollusca, and especially bivalve species.

Bronn has prepared the following synoptical table of the number of genera and species of prosobranchiates occurring in each geological formation; aggregating 7123 species: it would be largely increased, but its relative proportions probably not much changed, by the incorporation of material since made known to science.

PALÆOZOIC. 737 species. 57 genera.	{ Silurian,	164 species,	11 genera.	
	{ Devonian,	244 “	20 “	
	{ Carboniferous,	312 “	26 “	
	{ Permian,	17 “		
SECONDARY. 1764 species. 166 genera.	{ Triassic,	393 “	36 “	
	{ Jurassic,	488 “	56 “	
	{ Cretaceous,	883 “	74 “	
TERTIARY,		4622 “	179 “	

The relations of the tertiary with the recent mollusca are daily appearing to be more intimate. It is probable that a very considerable proportion of its species will be found to be synonymous with existing forms, and that the more comprehensive views of nature which have now obtained (and which are the happy result of the development theory—whatever may be said of the justness of its ultimate conclusions), will enable us to make proper allowances for influences producing variation in fossils as we do in recent species. Time has not been the only factor: as many of our so-called extinct species are obtained from particular local deposits, their characteristics, probably, are frequently more local and varietal than specific. Hundreds of cases might be cited of variations from a known specific type

of recent mollusks, where the differences are much greater than those which palæontologists, seeking distinctive characters for their periods or formations, have been accustomed to consider as of specific and even generic value.

Bronn has also prepared a table of the number of species of each genus of prosobranchiates appearing in the various formations, with the totals of species, fossil and recent, appertaining to each. As in his table just quoted, much allowance must be made for increase of species made known since his publication. The genera are within the Lamarekian limits.

Number of Species.

	Silur.	Devon.	Carb.	Perm.	Triassic.	Juras.	Cret.	Tertiary.	Total fossil.	Recent species.	Total species, fossil and recent
CHITON.....		18		1	1			11	31	200	231
PATELLA.....	6	19	1		2	16	10	38	98	100	198
FISSURELLA.....		2					5	23	30	84	114
EMARGINULA.....						4	7	23	34	26	60
CAPULUS.....	1	10			1			12	24	7	31
PILEOPSIS.....	2	9					4	23	40		40
CREPIDULA.....								16	16	40	56
CALYPTRÆA.....								11	11	50	61
SIGARETUS.....		3						12	15	26	41
NATICA.....	5	20		1	6	23	56	88	230	100	330
NERITA.....	3	8				7	2	30	52	120	172
NERITINA.....		1				1		30	34	100	134
AVELLANA.....							13		13		13
NERINÆA.....						56	46		92		92
TURBONILLA.....		9		1				22	32		32
LOXONEMA.....	2	20		1					23		23
MACROCHEILUS...	1	14	1	1					17		17
SCALARIA.....		1				1	18	80	100	100	200
TURRITELLA.....	4	29	4	1	6	17	71	107	296	30	326
PHASIANELLA.....		5			1	2	9	11	29	22	51
LITTORINA.....	1	2	2			3	8	15	31	60	91
TURBO.....	18	32	1	2	8	50	58	57	264	75	339
DELPHINULA.....		2				7	4	36	55	30	85
EUOMPHALUS.....	28	60				2			90		90
SOLARIUM.....						2	34	65	102	25	127
ROTELLA.....		4				4	1	4	15	10	25
PHORUS.....							3	14	17	7	24
TROCHUS.....	5	21	1	3	1	66	51	178	362	160	522
MURCHISONIA.....	18	30		1					48		48
SCHIZOSTOMA.....	4	13							17		17
PLEUROTOMARIA..	28	128		5	1	41	63	2	310	2	312
CIRRUS.....		2	1			7	1		14		14
CERITHIUM.....		1	1				36	327	367	90	457
ROSTELLARIA.....					4	14	60	16	94	6	100
PTEROCERAS.....						11	17		27	10	37
STROMBUS.....							5	31	36	70	106
MUREX.....						5	13	179	187	210	397
FUSUS.....		1			1	7	53	290	357	100	457
PYRULA.....	1	2					17	36	56	40	96
PLEUROTOMA.....							6	344	350	370	720
FASCIOLARIA.....							2	32	34	15	49
CASSIS.....						1		35	36	35	71
BUCCINUM.....		7	3		1	15	5	142	173	100	273
TEREBRA.....						5	2	30	37	110	147
VOLUTA.....							13	93	106	70	176
MITRA.....							2	110	112	350	462
OLIVA.....								32	32	120	152
CYPRÆA.....							3	79	92	160	242
CONUS.....							3	89	92	270	362
Total.....	127	473	15	17	33	367	701	2783	4516	3500	8016

The prosobranchiates may be divided into the following orders:

Order PECTINIBRANCHIATA.

The mollusks of this group have pectiniform branchiæ; that is, composed of leaflets arranged like the teeth of a comb, in one or two series or lines, and situated upon the upper wall of a respiratory cavity formed by the mantle, having an external opening upon the side of the neck. Sexes separated, in different individuals (diœcious). The shell is spiral.

Order SCUTIBRANCHIATA.

Branchiæ pectinated, placed in a cavity in the upper part of the neck, or at the inferior edge of the mantle, around the foot. Diœcious usually. Shell spiral (globular or pyramidal) or conical, holostomate, or with entire margins without anterior canal.

Order POLYPLACOPHORA.

Shell multivalve, consisting of eight separate pieces inserted upon the back of the animal and surrounded by a mantle-border.

Order NUCLEOBRANCHIATA.

Pelagic animals, swimming by means of fin-like lobes of the foot; with or without a shell, the latter being glassy, transparent; branchiæ partially or perfectly developed, forming a sort of nucleus on the posterior part of the back—whence the ordinal name. Diœcious.

This small group appears to form a connection with the Nudi-branchiate division of the Opisthobranchiata on the one hand, whilst on the other its specialized swimming organs and the consistency of its shell ally it to the Pteropoda.

ORDER PECTINIBRANCHIATA.

FAMILY MURICIDÆ.

Shell spiral, turriculated, with an anterior canal; the whorls thickened by varices or nodules at each rest-period in its growth. Operculum with subapical or lateral and marginal nucleus. Lingual dentition (x, 17, 19).

Subfamily MURICINÆ. Three or more varices on each whorl, the varices being nodulous, foliated or spinose; canal long or short, but well-marked.

Subfamily PURPURINÆ. Without varices, but tuberculate; columella flattened or patulous; basal canal very short or a mere notch.

SUBFAMILY *MURICINÆ*.

MUREX, Linn.

Spiny rock shell. *Syn.*—*Aranea*, Perry. *Centronotus*, Swn. *Muricanthus*, Swn. *Muriciæa*, Swn. *Haustellum*, Klein. *Brontes*, Montf.

Distr.—200 sp. World-wide, mostly tropical and subtropical; low water to fifty fathoms or more. *M. tenuispina*, Lam. (xliii, 1). Fossil, 160 sp., commencing with the Eocene.

Shell ovate or oblong; spire prominent; whorls convex, crossed by three or more continuous varices; aperture ending below in a canal, which is generally partly closed.

Murex erinaceus (xliii, 10) is a well-known depredator on the oyster-beds of Europe, and is considered one of the most dangerous enemies with which the ostreiculturist has to contend. So destructive is it in the oyster-parcs of Arcachon (near Bordeaux), that it is incessantly hunted by the fishermen, who spend whole days in destroying it by removing with a knife a portion of the foot and the operculum, after which the animal is left to die at its leisure or become the prey of other carnivores. The *Murex* seats itself firmly upon the shell of the oyster, and applies its rostrum to the surface of the latter, invariably at a point near the beak; after which a regular movement of the body to right and left ensues during a term of three or four hours, and results in piercing a small, round hole through the oyster shell, exposing the most essential viscera to the rapacity of the patient tunneler. It is believed that the denticles of the tongue are applied to the surface to be bored, and then the gyration of the animal gradually rasps through the hole; it has been supposed by some that an acid solvent is also used in this operation, but this is only conjectural. M. Fischer has observed at Arcachon that young *Murices* choose young oysters, whilst adults select larger oysters. The bored oyster soon dies or else, exhausted, opens its valves, when a myriad of other animals—crabs, mollusks, worms, fishes—hasten to profit by the fruit of the winkle's labor.—*Jour. Conch.*, 5, 1865.

The ancients obtained their purple dye from species of *Murex*. The small shells were bruised in mortars, the animals of the larger ones taken out. Heaps of broken shells of the *M. trunculus*, and the caldron-shaped holes in the rocks where they were triturated, may still be seen on the Tyrian shore. On the coast of the Morea, there is similar evidence of the ancient employment of *M. brandaris* for the same purpose.

In the following synopsis of subgenera, the discriminative characters used separate widely groups which really appear to be closely related: thus, *Cerostoma* and *Pteronotus* are intimately allied, notwithstanding the difference of the operculum;

and Phyllonotus and Chicoreus have the same general facies, although they differ in the number of varices. Owing to their inter-relationships, no attempt to present the groups in succession can be other than exceedingly artificial.

a. Operculum with subapical nucleus.

** Varices three.*

MUREX (typical). Shell spinous; spire elevated; canal very long, narrow, nearly straight.

PTERONOTUS, Swainson. Shell triangular; varices fin-like or foliated; canal moderate, closed, somewhat curved. *M. trigonulus*, Lam. (xliii, 2).

CHICOREUS, Montf. Shell ovate-pyriform; varices foliated and sometimes spinose; canal short, curved, wide, nearly closed. *M. adustus*, Lam. (xliii, 3).

ODONTOPOLYS, Gabb. Resembles the subgenus Pteronotus in having three varices on each whorl, but distinguished by the crenulations of the outer lip and by having two transverse plaits or folds on the middle of the columella. *M. compsorhytus*, Gabb (xliii, 4). Eocene; Wheelock, Texas.

** * Varices four to ten.*

RHINOCANTHA, H. and A. Adams. Has the short body-whorl and long canal of the typical Murices; differs in having more numerous varices. *M. cornutus*, Linn. (xliii, 5).

HOMALOCANTHA, Mörch. Whorls rounded and sutures very deep; varices foliated, and peculiarly produced into expanded digitations; canal long. *M. scorpio*, Linn. (xliii, 6).

PHYLLONOTUS, Swains. Like Chicoreus, but varices numerous. *M. radix*, Gmel. (xliii, 7).

b. Operculum purpuroid.

** Varices three.*

CEROSTOMA, Conrad. Varices wing-like; aperture usually dentate within the outer lip, with a produced tooth near its base. Analogous with Pteronotus. It is very difficult to define the boundary between this group and Pteronotus, inasmuch as the operculum of several of the species is not known; moreover, the labral tooth does not always appear even in those species having a purpuroid operculum. All the species with more than one inter-variceal node appear to be true Pteronoti, and the distribution of the group is mainly Indo-Pacific; Cerostoma, on the other hand, is North Pacific in distribution, extending from Japan northwards to Behring's Straits, and on the opposite American coast south to Central America. *M. Nuttallii*, Conr. (xliii, 8).

** * Varices numerous.*

VITULARIA, Swainson. Shell oblong; spire short; body-whorl

long; canal very short, wide; outer lip thickened and dentate within. Varices nearly obsolete. *M. miliaris*, Gmel. (xliii, 9).

OCINEBRA, Leach. (Muricopsis and Corallinia, Bucq. and Dautz.) Spire elevated; canal more or less closed; varices foliated, sometimes spinose. *M. erinaceus*, Linn. (xliii, 10).

This group, as well as Muricidea, is made by Messrs. Adams an *omnium gatherum*, including true Murices, purpuroid Murices, Purpuræ, Fusidæ, etc. Muricidea as defined by them has no really distinctive characters from Ocinebra, and Swainson included species of Trophon, Triton, etc. I have suppressed Muricidea, and retained Ocinebra for a group of small Murices with numerous varices and purpuroid operculum; the species having muricoid operculum should be relegated to Phyllonotus, from which they do not differ.

PTEROHYTUS, Conrad. Not characterized. The type has lamellar varices like *Cerostoma foliatum*, but more numerous than in that group, and the outer lip has a tooth. I think it may be safely relegated to Phyllonotus, Swains. *M. umbrifer*, Conr. (xliii, 11). Miocene; Virginia.

UROSALPINX, Stimpson.

Syn.—Adamsia, Dunker. Agnewia, T.-Woods.

Distr.—20 recent species. Atlantic Coast of America, Cape Horn, Cape of Good Hope, New Zealand, etc. *U. Floridana*, Conr. (xliii, 12).

Fusiform. No proper varices, which are replaced by longitudinal ribs.

Shell elongated oval, or short fusiform, longitudinally ribbed or undulated and spirally striated; aperture with a short canal; outer lip dentate and lirate within. Operculum somewhat like that of *Purpura*, semicordate, with the nucleus at the outer edge a little below the middle. Lingual dentition nearly like that of *Trophon*.

It differs from *Trophon* in its operculum, and from *Ocinebra* in its smoother shell, want of distinct varices, and open canal.

Urosalpinx cinerea occurs upon the Atlantic coast of the United States from Maine to Florida. The animal is small, foot scarcely covering the aperture, very little dilated at the front angles, cream-colored, margined with lemon-color beneath, punctured with light drab above; siphon merely surpassing the tip of the canal; head scarcely protruded; tentacula nearly united at origin; eyes black, at the outer upper third of tentacula, which third is a mere filament, contractile. Motions sluggish.

Littoral. The eggs are contained in small transparent membranous parchment-like vases, each of which is attached by an expanded foot to some solid substance, usually the under surface of an overhanging rock, a little above low-tide mark. Each female deposits from ten or twelve to more than a hundred of

these vases, the process of laying occupying several weeks. The vases are generally attached in more or less regular rows, covering sometimes an area of three or four square inches. In shape and size they are like the egg-cases of *Purpura*, but without the slight reddish tinge of the latter. They are flattened vertically, and their edges are marked by keel-like ridges. Unlike the vases of *Purpura*, each of which contains several hundred eggs, those of *Urosalpinx* contain only from six to twenty, ten or twelve being the usual number.

SCALASPIRA, Conrad, is certainly closely allied to, if not identical with *Urosalpinx*; if the latter, it has priority: it would scarcely be advisable, however, to reject Stimpson's well-characterized genus in favor of one having no diagnosis, and only known by its type. *Scalaspira strumosa*, Conr. Miocene; Virginia.

EUPLEURA, H. and A. Adams.

Distr.—5 sp. Atlantic Coast of United States, West Indies, Panama. *E. caudata*, Say (xliii, 13).

Ranelliform, with a pair of lateral varices, one on either side, and intermediate smaller varices; aperture dentate within.

The lingual dentition differs entirely from that of *Ranella*, and resembles *Murex*: the shell also resembles some of the small Murices, and particularly *Urosalpinx*. The geographical distribution of the group is entirely different from that of *Ranella*.

TYPHIS, Montfort.

Etym.—*Typhos*, smoke.

Distr.—15 recent species. Mediterranean, Cape, Ind. Ocean, Tropical America. *T. tetrapterus*, Bronn (xliii, 14). Fossil, 8 sp. Eocene—; London, Paris.

Ovate or oblong, with projecting hollow tubes between the three spinose varices; aperture suborbicular, prolonged in front into a closed siphonal canal.

The ascending tube which is the distinguishing feature of the shells of this genus is occupied by an extension of the mantle-margin of the animal.

The operculum is ovate, with apical nucleus, like that of *Murex*.

TROPHON, Montfort.

Etym.—*Trophonius*, a mythological deity.

Distr.—40 species. Mostly cold seas; typically Arctic and Antarctic. *T. clathratus*, Linn. (xliii, 15). Fossil; Chili, California, England, etc.

Varices numerous, lamelliform or lacinated; spire prominent; aperture ovate; canal open, usually turned to the left; shell white, often dark-colored within the aperture.

The typical Trophon has a fusiform shell, thin and white, the whorls with numerous, sharp, laminated varices, the interstices smooth, or spirally ribbed; canal open, usually turned to the left; no umbilicus; lip thin, smooth within. This group is essentially boreal in distribution. There is, however, another group of species inhabiting the southern temperate and Antarctic zones, which, whilst possessing the main features of the type, the laminae and the white color, present peculiar characters. These shells are usually broadly ovate, shouldered, umbilicate, the aperture dark-colored within. They form a transition to Siphonalia, and might with almost equal propriety be included in that genus. Montfort's definition of the genus Trophon, indeed, does not correspond so well with the typical group as now recognized, as it does with these Siphonalia-like shells.

SUBFAMILY PURPURINÆ.

The Muricidæ naturally subdivide into two groups, one of them (Murices) distinguished by varices on the shell, operculum with terminal initial point, whilst the other (Purpuræ) has nodules but no varices, patulous columella, short canal or mere basal notch, operculum with lateral nucleus; yet on the confines of these two groups occur forms which partake of the characters of either, and the classification of which is entirely arbitrary. Ocinebra, species of Trophon, Urosalpinx and Eupleura have undoubted relationships with Purpura, yet are classed with Murex—partly because the species have usually been considered or were described as Murices; on the other hand, *Purpura crispata* and its allies possess the variceal features of Murex. Kobelt has, on this account, included them in his catalogue of the genus Murex; but on account of the extreme variability of the species (some specimens being without varices) and the number of connecting forms between the smoother varieties and typical Purpuræ, I prefer to retain them in the group to which they have usually been referred.

If the difficulty of defining these two subfamilies is great, still greater does it become when we descend to the genera and subgenera of either of them. Various authors have attempted it, from the "groups" of Kiener's monograph to the genera and subgenera of H. and A. Adams. I adopt the latter as a mere convenience, premising that nature presents her specific forms here (as frequently elsewhere) in such continuous series, that no real line of demarcation can be traced; the characters selected represent simply the high tide of an osculation, which at its ebb merges into the next incoming wave.

PURPURA, Bruguiere.

Syn.—Mancinella, Link. Microstoma, Sw. Thais, Link.

Distr.—57 sp. All parts of the world, low water to 25 fathoms. *P. Persica*, Linn. (xliv, 16). Fossil, 40 sp. Tertiary—.

Shell oblong-oval, last whorl large; spire generally short; aperture ovate, large, terminating in a very short, oblique channel, or notched; columella flattened; outer lip simple.

The animal does not differ essentially from that of *Murex* in its general external and anatomical characters. The eyes are usually placed near the tips of the tentacles, the siphon is short, and the foot not large.

This is one of the genera from which the ancients obtained dyes; by pressing on the operculum of *P. lapillus* (xliv, 22), a fluid will be obtained which colors a dull crimson. The metropolis of this form is Northern Europe; the North American specimens, as well as those from Southern Europe and North Africa, being stunted in comparison of size and ornamentation. Its fossil distribution ascends as far back as the Red Crag of England. It lives gregarious on rocks and stones within the tides, where it preys on mussels, limpets, and barnacles. It is especially fond of oysters, and is considered a destructive enemy by the cultivators of the bivalve. A single reversed, as well as a scalaroid specimen are recorded by Mr. Gwyn Jeffreys. He says that "this mollusk has a shambling gait and sedentary habits, and seems to be always eating or digesting its food. Lister, however, observed it early in the morning, at the commencement of June, otherwise engaged, viz., in perpetuating its species on a dry rock after the tide had receded. It is very destructive to mussel-beds, and is said by Linné to eat the dead fish left in fishermen's nets. I have seen it busily feeding on *Balanus balanoides*, its strong proboscis being inserted between the opercular walls of the barnacle. According to Mr. Osler, it also devours *Littorinæ*, *Trochi*, *Naticæ*, and even its own kind. From what I have observed of the mode by which it perforates the shell of a mussel, I am inclined to agree with Mr. A. Hancock, that it uses its tongue. I cut off the end of the proboscis of a *Purpura* while it was attacking a mussel; the part thus lopped still remains in the hole, with the front of the tongue exposed. The hole is shaped like an inverted cone, and exhibits under the microscope extremely fine scratch-like striæ, as if caused by the rasping action of the lingual apparatus. I believe the movement to be rotatory, because the sides of the hole are quite even. The process is an extremely slow one. Mr. Osler states that, after watching for some hours a *Purpura* attached to a Limpet, he found the perforation incomplete; and Mr. Spence Bate and Mr. Bretherton noticed that it took two days to get through the shell of a moderate-sized mussel. It does not appear that the prey is destroyed by any poisonous secretion of the whelk, after it has gained access to the interior. The proboscis is at

first thrust into the hole which it had drilled, and the whelk eats in that way; but when, from the death of the mussel or limpet, the former gapes or the latter separates from the rock, the *Purpura* devours the remainder by the natural opening.

"According to Mr. Peach, it deposits its spawn all the year round, but more actively from January to April. Spawn which he collected in January, 1843, was hatched four months afterwards; he took forty-seven fry from a single capsule. They soon began to assume the peculiar habit of their parents, by getting out of the water, where they would remain for hours, answering to the period of the ebb and flow of the tide."—JEF-FREYS, *Brit. Conch.*, iv, 279.

Like all other predacious and voracious beasts, the *Purpura* meets with retribution occasionally; here is an instance:

Mr. Henry Crowther, whilst collecting in the shore pools at Whitby, England, "noticed a commotion amongst the mollusks which was of too brisk a nature for their well-known and characteristic slowness. When the obscuring sands which they had thrown up in the fray had settled, he saw that the shells were principally in the possession of hermit crabs, which, under this guise, were attacking a *Purpura lapillus* and dragging it from its shell. We caught the whole school at once and transferred them to a collecting-bag; the shells occupied were *Nassa pygmæa*, *Trochus cinereus*, *Littorina littorea*, three sizes, and a *P. lapillus*, the sheik of the party, for he was taken red-handed. We presume to think that if their object had not been frustrated, there would have been ere long a mutual exchange of crab's clothing."

M. Bouchard-Chantereaux observes that the shells of *Purpura lapillus*, found on the Boulonnais (France) coast are thinner and smaller in those situations where they are subject to the influence of brackish or fresh water. It is very fond of *Mytilus edulus*, *Mactra*, *Donax*, etc., the shells of which it bores through in from three to five minutes, preserving perfect immobility during the operation, and protecting the tongue from contact with the sea water by applying the two anterior lobes of its foot closely around its mouth. After boring the shell of its victim, the mantle is torn away, and the viscera only devoured.—*Jour. de Conch.*, p. 124, 1879.

PURPURA (typical). Shell oblong-oval, last whorl large; spire generally short; aperture ovate, large with an oblique channel or groove at the fore-part; columella flattened; outer lip simple.

PURPURELLA, Dall. Aperture contracted; outer lip strongly dentate within; columella flattened, with one or two distinct spiral ridges upon its centre.—*P. columellaris*, Lam. (xliv, 17).

TRIBULUS, Klein. Spire depressed, whorls simple, the last ven-

tricose; aperture wide; columella arcuated; inner lip excavated, corrugated at the fore-part. *P. planospira*, Lam. (xliv, 18).

THALESSA, H. and A. Adams. Spire elevated, whorls spinose, angulated at the upper part; aperture moderate; columella rounded, tubercular in front; outer lip nodulous internally. *P. hippocastaneum*, Lam. (xliv, 19).

STRAMONITA, Schum. Spire elevated, whorls simple or nodulous; aperture moderate, produced anteriorly; columella rounded, simple in front. *P. Floridana*, Conr. (xliv, 20).

TROCHIA, Swains. Whorls separated by a deep groove; inner lip thickened, convex, striated; aperture with a very short canal. *P. cingulata*, Lam. (xliv, 21).

POLYTROPA, Swains. Spire acuminate, whorls foliated or tuberculose; inner lip flattened; canal small, oblique; aperture narrowed at the fore-part. *P. lapillus*, Linn. (xliv, 22).

CRONIA, H. and A. Adams. Shell ovate; spire acuminate; aperture moderate; inner lip callous at the upper part; columella straight, simple anteriorly. *P. amygdala*, Kiener (xliv, 23).

PURPURELLA, Bellardi, 1882. Aperture with a posterior canal, defined by callous margins. *P. canaliculata*, Bellardi. Tertiary; Northern Italy.

TAURASIA, Bellardi, 1882. Aperture canaliculate posteriorly, with callous margins; columella with an anterior plication. *P. subfusiformis*, d'Orb., and two other species. Tertiary; Northern Italy. Neither this nor the preceding group possesses characters of much importance.

[SINUSIGERA, d'Orb.

Syn.—Cheletropis, Forbes.

Examples.—*S. cancellata*, d'Orb. (xx, 47). *S. Huxleyi*, Forbes (lxxxvii, 13).

Turbinate, imperforate, dextral or sinistral, with a smooth, striate or tuberculate surface and frequently, a keeled periphery; aperture channeled in front, peristome thickened, reflected, with one or two claw-like lobes.

The animal has four arms, arranged in cruciform manner and used for swimming. There are two tentacles, and the eyes, well-formed, are situated on the outer side of their bases. Respiratory siphon short, being a simple fold of the mantle. Foot large and very mobile, furnished with a small, thin spiral operculum; unprovided with a float. The dentition (xx, 48) has been supposed similar to that of the Muricidæ—and the species have, consequently, been referred, as larval forms to that group.

Dr. Jousseaume has established the identity of a species of Sinusigera with *Purpura hæmastoma*, of which it is the larval form—his series of specimens of various ages, collected at Benguela, on the West Coast of Africa, showing a gradual develop-

ment of the adult character. The young *Purpura* shells retain the embryonic *Sinusigera* at the summit of the spire for a considerable period, but it is eventually lost by erosion. That all the species which have been referred to *Sinusigera* are larval forms of various species of *Purpura* does not follow, from this observation; some of the related genera may be involved. Mr. Arthur Adams has identified another species of *Sinusigera* with *Purpura biserialis*, and Mr. Craven thinks that his *S. perversa* is the young of a *Triforis* or of some allied genus in *Cerithiidae*.

Sinusigera is pelagic, and is encountered in mid-ocean, in tropical seas having feeble currents and where calms prevail.

Mr. Craven, who has recently monographed the genus, enumerates twenty species.]

PURPUROIDEA, Lycett.

Distr.—*P. nodulata*, Lycett (xliv, 24). Oolite, England.

Shell turriculated, ventricose; summit of the spire sharp; whorls convex, with a line of spines or tubercles on the shoulder; columella smooth, rounded, excavated in front; siphonal notch wide, no groove at the posterior junction of lip and columella; outer lip thin. Fossil.

This fossil genus has been confounded with *Purpurina*, d'Orb.: its typical forms appear to be close to *Purpura*, and the species I figure has some resemblance to the recent *P. chocolatum*; whereas *Purpurina* is nearly related, apparently, to *Cancellaria*. The distinctive character from *Purpura* consists in the close junction of lip and columella posteriorly.

LYSIS, Gabb.

Distr.—*L. duplicosta*, Gabb (xliv, 25, 26). Cretaceous, California.

Stomatiform, very oblique; spire moderate; whorls costate; aperture narrow, outer lip simple, inner lip straight, concavely expanded over the wide umbilicus so as to completely cover it.

Supposed by Gabb to be nearly related to *Stomatia*; I have examined authentic specimens, and do not hesitate to refer it to the *Purpuræ*.

IOPAS, H. and A. Adams.

Distr.—*I. sertum*, Brug. (xlv, 40). Polynesia.

Shell ovate, rugose, last whorl large; spire acuminate; aperture moderate, emarginate and channeled in front; columellar lip covered with a thin enamel, and with a prominent plait-like callosity at the hind-part; outer lip sinuous, crenate within.

VEXILLA, Swainson.

Distr.—4 sp. Japan, Philippines, Polynesia. *V. vexillum*, Chemn. (xliv, 27).

Shell purpuriform; inner lip flattened and depressed, but outer lip, when adult, thickened, inflected and toothed; aperture wide.

USILLA, H. Adams. Founded on *V. fusco-nigra*, Pease, which differs from the typical *Vexilla* in the spire being acuminate, and the aperture somewhat contracted or narrowed.

Pease (*Am. Jour. Conch.*, iv, 115) adopts the subgenus, and adds to it *Purpura leucostoma*, Desh., and *Planaxis cingulata*, Gould. I very much doubt whether the group will stand, as the little specimen of Pease's species before me is very suggestive of *Pisania*, and Deshayes' species is a true *Purpura*, and evidently very closely allied to, and as I believe = *P. columellaris*. The opercula of Pease's and Gould's species are unfortunately undescribed.

RICINULA, Lam.

Etym.—Diminutive of *ricinus*, the (fruit of the) castor-oil plant.

Syn.—*Canrena*, Link. *Drupa*, Bolt. *Pentadactylus*, Klein.

Distr.—*R. horrida*, Lam. (xlv, 28, 29). 30 sp. India, China, Philippines, Australia, Pacific, Panama, Red Sea, Natal, West Indies, Brazil. 3 fossil sp. Miocene—; France.

Shell ovate, solid; spire short, whorls tubercular or spinous; aperture linear, narrow, contracted by callous projections, with a short, oblique, emarginate canal in front; inner lip tubercularly wrinkled; outer lip internally with plait-like teeth, often digitate.

SISTRUM, Montfort. (*Morula*, Montf.) Has usually a longer spire, the shell is smaller, more fusiform, the teeth within the outer lip not grouped, but single. This separation has its conveniences: nevertheless the characters, as in so many other groups, only serve well for the recognition of some of the forms; others must be arbitrarily placed. The dividing line between *Sistrum* and *Engina*, *Latirus* and some *Pisanoid* species is very difficult to trace. The group is essentially Polynesian in distribution, frequenting coral reefs. *R. morus*, Lam. (xlv, 30).

MONOCEROS, Lam.

Etym.—*Monos*, one, *ceras*, a horn.

Syn.—*Acanthina*, Fischer. *Rudolpha*, Schum. *Unicornus*, Montf.

Distr.—10 sp. California to Chili. Tertiary of Chili. *M. giganteum*, Lesson (xlv, 41). *M. lugubre*, Sowb. (xlv, 42).

Shell ovate, last whorl large; spire rather elevated; aperture semilunar; inner lip wide and flattened; outer lip crenated, with a prominent tooth at the fore-part.

PSEUDOLIVA, Swainson.

Etym.—Resembling *Oliva*.

Syn.—*Sulcobuccinum*, d'Orb. *Gastridium*, Gray. *Buccinorbis*, Conr. *Pseudodactylus*, Herm.

Distr.—6 sp. E. Africa. *P. plumbea*, Chemn. (xlv, 43). Fossil. Eocene of America and Europe.

Shell ovate, solid, subglobose; spire very short, suture slightly channeled, whorls tumid round the upper part; aperture oval, canal very short; inner lip arcuated, with a callosity at the hind-part; outer lip thin, furnished at the fore-part with a small tooth or callosity.

The shell has some resemblance to *Monoceros* in its tooth on the outer lip, and its operculum is purpuroid; it also resembles the *Olivancillariæ*. The animal is unknown. H. and A. Adams described a subgenus *Macron*, in which are included several species from the West Coast of America, but this group must be eliminated, as the operculum has since been ascertained to be unguiculate. *P. Australis* is now placed among the *Eburnæ* as subgenus *Zemira*.

CHORUS, Gray.

Distr.—*C. Belcheri*, Hinds (xlv, 43, 44). Japan, California.

Shell laminately varicose, spinose on the shoulder; canal rather long; outer lip with a spine as in *Monoceros*.

To this group have been referred *Ch. monoceros*, Desh. (= *Monoc. giganteum*, Lesson), *Ch. xanthostoma*, Brod. (= *Trophon*), and *Ch. Belcheri*, Hinds. These three species are certainly representatives of three distinct genera, of which the last only remains to represent this genus. The dentition of *Ch. Belcheri* reminds one of the *Buccinidæ* more than any other group, and is nearest to that of the subfamily *Photinæ*; but the shell does not bear out this relationship, its spines, peculiar varices and long canal suggesting *Trophon*, from which it is distinguished by having a purpuroid operculum and the tooth of a *Monoceros*. A naturalist fond of making systematic groups might construct for this species a family, to follow, perhaps, *Ptychatractidæ* and intervening between the latter and *Buccinidæ*. In placing it between *Monoceros* and *Pseudoliva* and *Rapana*, I think that I have adopted the best alternative to the course above suggested.

PINAXIA, A. Adams.

Distr.—*P. coronata*, A. Ad. (xliv, 31). Polynesia.

Shell conical; spire short, acute; aperture oval-oblong, emarginate anteriorly; inner lip flattened, with several transverse plaits in the middle; outer lip acute, grooved internally.

The shell has some resemblance to *Pyrula pugilina* in form as well as in the revolving raised lines within the aperture, but differs in possessing plications upon the columella. Mr. E. A. Smith has, fortunately, received specimens with the operculum in situ; this is purpuroid, and definitely settles the proper place of the genus. The animal is unknown, and a description of it,

and its dentition particularly, is desirable. The plications of the columella only appear upon old specimens, and the tubercles of the shoulder of the body-whorl are not always developed.

CONCHOLEPAS, Lam.

Syn.—Conchopatella, Chemn.

Distr.—*C. Peruviana*, Lam. (xlv, 45). West Coast of South America.

Shell ovate, last whorl very large, expanded; spire very short, obliquely inclined towards the left side; aperture very wide, slightly channeled anteriorly; inner lip flattened; outer lip with two small teeth in front.

The single species has the basal groove of *Monoceros* and *Pseudoliva*, but its margins are defined by two sulci, giving rise to two horns, instead of one, on the edge of the outer lip. The immense development of the last whorl gives the shell a somewhat limpet-like rather than a spiral appearance. In consequence of this great enlargement of the aperture the operculum, which is purpuroid in its growth, is entirely unfitted to close the aperture, and, in fact, becomes a useless appendage. The shell is used by the Magellanic tribes as a drinking-cup, and by the Chilians the foot is eaten, being well-beaten to render it tender. Large piles of shells around the cabins of the fishermen testify their appreciation of this mollusk as an article of food. The large foot, like that of the limpets, adheres by suction to rocks, and so tightly that the shell is detached from them with extreme difficulty, unless suddenly removed before the animal becomes aware of danger.

Mr. A. Adams formed a subgenus *Coralliobia* for *Conch. fimbriatus* described by him in 1852; subsequently this subgenus and its type were ranged under *Leptoconchus* in H. and A. Adams' "Genera." This latter disposition I consider correct.

CUMA, Humph.

Syn.—*Cymia*, Mörch.

Distr.—9 sp. Panama, Indian Ocean, China, West Coast of Africa. *C. Kiosquiformis*, Duclos (xliv, 32).

Shell pyriform; spire elevated, acute, whorls angular or spinose; aperture oval-oblong; columella convex, sometimes with a strong angular tubercle in the middle; outer lip acute, grooved internally.

This small group is related by some of its species to *Rapana*; by others, to *Rhizochilus*.

The genus *Cuma* of Humphrey is founded upon a number of species, of which about one-half have been identified and referred to other genera, and no species remains which can be certainly made to represent the group. Mörch, inasmuch as Milne-

Edwards has used the name in Crustacea, in 1828, proposed *Cymia* for these shells. I am not disposed to disturb a well-known name, even under these mitigating circumstances; besides, it is not impossible that Milne-Edwards' genus may itself be superseded by some other name or dismembered, and nothing left of it, as in our old genus *Pyrula*.

Humphrey may not have understood what limit he ought to have given to his genus *Cuma*, and whilst I do not think that he has any very strong claim on us for the recognition of any of his names, I am unwilling to increase the already confused state of our nomenclature by attempting to follow out the absurd and impracticable "rule" of the British Association. Every naturalist knows that the names of genera in his specialty are repeated in other branches of natural science, and accepted without hesitation, and that we only follow the "rule" by changing a duplicated name occasionally. Besides, no one pretends to be a general naturalist in these days, and the conchologist will not find himself embarrassed by the use of the generic name *Cuma* in any other subkingdom of nature, or in all of them, whilst he would be "very considerably bothered" upon encountering the name *Cymia*.

RAPANA, Schum., 1817.

Syn.—*Ecphora*, Conr. *Stenomphalus*, Sandb.

Distr.—8 sp. China, Japan, Philippines, Australia. *R. bezoar*, Linn. (xlv, 46).

Shell ventricose, axis perforated to the apex; spire depressed; aperture oval, narrowed anteriorly; canal open, slightly recurved; inner lip reflected, free anteriorly; umbilicus wide, corrugated.

This well-characterized group includes a few species usually found upon coral reefs in tropical seas, and probably living upon the coral polyps.

Fusus quadricostatus of Say (xlv, 47), a common American tertiary fossil and very remarkable shell, is referable to this genus: Conrad has formed for it his genus *Ecphora*.

LATIAxis, Swainson. Whorls more or less detached, carinated; aperture small, trigonal; canal narrow, rather long, curved. The animal and operculum are unknown. *R. Mawæ*, Gray (xlv, 48).

[PSEUDOMUREX, Monterosato.]

An aberrant form, referred by authors to *Murex*, to *Coralliophila* and to *Latiaxis*. I cannot find any good characters by which to separate it from *Coralliophila*. It includes four species and numerous varieties, all inhabiting the Mediterranean Sea. *P. bracteatus*, Brocchi.

RHIZOCHILUS, Steenstrup.

Distr.—22 sp. Coral Reefs, Pacific, West Indies.

Shell when young free, resembling *Rapana*; when adult, sometimes with more or less irregular solid shelly extensions of the outer and inner lips, which clasp the axis of coral or the surface of neighboring shells, and at length close the mouth with the exception of the anterior siphonal canal which is converted into a shelly tube. No operculum(?).

We do not know how many of the species allied to the type of the genus may partake of this singular mode of growth; it has only been observed in *R. antipathicus* (xliv, 33, 34). A large number of species have been grouped by Messrs. H. and A. Adams in a subgenus *Coralliophila*, the character of which is, that they do not (are not known to) form this shelly enclosure. If this supposed difference of habit should be proved by observation, there can be no doubt that the two groups should be generically separated. It may be remarked that no lingual denticles have been found in the animals of *Coralliophila*, *Leptconchus* or *Magilus* examined by Troschel. *Coralliophila* possesses an operculum; I do not know whether the younger stage of *Rhizochilus* has one or not, but the presumption is that it has not.

CORALLIOPHILA, H. and A. Ad. (See remarks above.) A large number of specific forms have been described, many of which have not been figured. Judging from the extreme variability of the well-known species both in form and sculpture, it may be anticipated that most of the more recently characterized species will prove to be synonyms. *R. neritoidea* (xlv, 49).

GALEROPSIS, Hupé. I venture to place under this name the *Rhizochilus madreporarum*, Sowb. (xliv, 35), which possesses differential characters from both *Rhizochilus* and *Coralliophila*. The young shell is free, and not unlike a *Coralliophila*, and in this stage it has a small, thin operculum with lateral nucleus. The animal has a short siphon which scarcely projects beyond the canal. It is sluggish in its movements. As it matures it becomes attached to the coral, on which it lies and adheres with great tenacity, often allowing the foot to be torn away before releasing its hold. The conformation of the lip corresponds exactly with the irregularities of the place of adhesion. Upon removing the animal, scars will be noticed on the coral, more or less worn by the abrasion of the shell, and old specimens will be found to have deposited a shelly base. When removed, the animal is very timid and never wholly expands. It can only partly withdraw behind the columella-shelf, leaving a portion of the mantle and foot exposed. The foot is small, of an oval form, thick and fleshy. The tentacles rapidly taper to a fine point, on which the eyes are sessile a little beyond the middle of their length. The foot is tinged with pale orange, dotted with white along the upper margins. The mantle is colorless centrally,

tinged with orange along the margins and dotted with white, the dots crowded anteriorly and becoming more and more remote posteriorly. The operculum is of a pinkish violet color. The foot has a well-developed duplication in front. Such is the description given by Mr. W. H. Pease, who places the species in *Rhizochilus* proper; but it appears to me to differ from that genus in the excavated, shelf-like columella, the expanded continuous lip of the adult (very like *Concholepas*) and in not closing up its aperture with shelly matter when mature. In the expanded lip, flattened columella and tooth-like projection of the basal margin of the latter it well agrees with Hupé's genus *Galeropsis*, a tertiary fossil.

SEPARATISTA, Gray.

Syn.—*Lippistes*, Montf.

Distr.—4 sp. Cape, Philippines, Polynesia. *S. Chemnitzii*, A. Ad. (xlv, 36).

Shell turbate, subdiscoidal, the first whorls contiguous, the last more or less separated; aperture expanded, slightly angulated, the margin everted; umbilicus very wide, infundibuliform with the whorls visible to the apex. No operculum.

The animal is unknown, and the relationships of the genus are doubtful.

MELAPIUM, H. and A. Adams.

Distr.—1 sp. East Indies.

Shell ovate-pyriform, ventricose, imperforate, porcellaneous; spire very short, apex papillary; aperture expanded, inner lip with a thick, smooth callus at the hind-part, columella twisted anteriorly, with a prominent oblique plait; canal wide, recurved, directed towards the left. Operculum unknown.

This genus was instituted for the *Pyrula lineata* of Lam. (xlv, 50); the animal and operculum of which are unknown. Its systematic position is very doubtful. It has the porcellaneous texture of *Pusionella*; from which, however, it is distinguished by its ventricose body-whorl and short papillary spire.

WHITNEYA, Gabb. This fossil group is said by its author to be related, probably, to *Fasciolaria*, but I agree with Stoliczka that its nearest apparent ally is *Melapium*; from which I can only separate it geologically. *M. ficoides*, Gabb. Cretaceous; California.

RAPA, Klein.

Syn.—*Bulbus*, Humph. *Rapella*, Swn.

Distr.—2 sp. Indian Ocean to Polynesia. *R. papyracea*, Lam. (xlv, 51).

Shell thin, globosely pyriform; axis perforate; umbilicus partly concealed by the reflected inner lip; spire obtuse; aper-

ture oblong, produced anteriorly into a wide, subrecurved canal. Operculum unknown.

This, like the preceding genus, has only one properly authenticated species; and that is unquestionably very closely related to *Leptoconchus*. The operculum is of the normal purpuroid type, but like the shell, very thin, translucent and yellowish white.

MAGILUS, Montfort.

Syn.—*Campulotus*, Guett. (part). *Tubulites*, Davilla. *Lep-toconchus*, Ruppell.

Distr.—5 sp. Coral Reefs, Mauritius, Red Sea. *M. antiquus*, Lam. (xlv, 52, 53).

Shell when young, spiral, thin; when adult, white, solid, tubular, spiral for three or four whorls, the last prolonged into an irregular straight or flexuous tube, solid posteriorly, and with a siphonal keel on the left side. Operculum ovate, nucleus sub-lateral.

In the "Genera of Recent Mollusca," the authors, following Ruppell, distinguish the species of *Leptoconchus* from the single species of *Magilus*. They thus describe the animal of the former:

The mantle-margin is greatly thickened and fleshy; the tentacles are small, broad and united at their bases; the eyes are small and black, on the outer side of the tentacles, near their tips; the foot is small, short, obtuse and rounded behind, with a thin, expanded, disk-like lobe in front, and the siphon is obsolete. The genus differs from *Campulotus* (*Magilus*) not only in the absence of the operculum, but in the shell never forming a long tubular projection of the mouth as in that genus. It comprises but few species, which take up their abode in corals and madrepores.

Deshayes, in his "Conchology of the Island of Bourbon," 1862, describes a number of species of *Leptoconchus* as well as the anatomy of one of them, confirms the non-existence of the operculum and sustains the separation from *Magilus*.

On the other hand, that experienced conchologist, Mr. G. B. Sowerby, in his introductory remarks upon the genus *Magilus*, in *Conch. Iconica*, xviii, 1872, unites *Leptoconchus* with that genus. He says:

"The habits of this genus are very curious. The young fry, after a short period of free locomotion, seems to find its way into some hole in a growing madrepoire, and then to become stationary; but as the substance grows around it, it would soon become enclosed unless the growth of the shell kept pace with that of the madrepoire. In order, therefore, to keep its aperture close to the surface, the two lips are extended in the same direction in the form of an irregular tube. The *Magilus* leaves its

shell in the original cavity, and filling it up (with shelly material) so that it becomes solid, occupies only that portion of the tube which is nearest to the opening. The walls of the tube are thickened, and the portion which represents the canal is consolidated into a thick keel. The species which have not been found as yet in an advanced state, and which appear generically to resemble the young shells of *Magilus antiquus*, have been separated by authors under the generic term *Leptoconchus*; and it is asserted that while the *Magilus* possesses an operculum, the *Leptoconchi* do not. It is also said that the young shell of the *Magilus* begins to form a thickened and entire edge to its aperture, as if preparing for the future erratic course of its shell. It appears to me, however, that it depends upon the accidental conditions of habitat and growth whether and at what period of life the shell of a *Magilus* shall become tubular; and as for the operculum, it is certain that some, if not all, the species enumerated as *Leptoconchus* by authors have been found with opercula; notably, *L. Lamarckii*, Desh. The Isle of Bourbon, the Mauritius and Sandwich Islands—perhaps most islands with reefs—afford homes to the *Magili*.”

We agree with Mr. Sowerby; indeed, it would be impossible to designate from the shells which species should be referred to *Leptoconchus* and which ones to the juvenile condition of *Magilus*. It is probable that the development of the tube is accidental, and it is equally probable that, as in *Conus*, the operculum is not always developed. Troschel has not discovered any indication of armature upon the lingual ribbon. So irregular are the shells of the *Magili*, and so much is their growth influenced by the circumstances of their habitation, that all the species that have been differentiated from *M. antiquus* must be regarded with suspicion. When numbers of specimens, from different localities, and collected with a view to coalescence rather than to differentiation, shall have been compared, we shall be able to assign definite places to the species which we are now compelled to take on probation.

MAGILINA, Vélain.

Distr.—*M. serpuliformis*, Vélain (xliv, 37, 38. Indian Ocean.

Young shell free, formed of a single whorl; finally prolonged into a tube which is attached by one side to the surface of submarine bodies.

The species which forms the type of this genus is much smaller than those of *Magilus*. The distinctive characters consist in the spiral shell having one whorl only and in the fixed adult being attached by one side of the tube to the external surface of submarine objects, instead of growing in their interior. This is a great change of habit, and the animal may prove to have no rela-

tionships with *Magilus* but rather with *Vermetidæ*. I do not know how closely it may be related to *Nisea*.

NISEA, Marcel de Serres.

Distr.—*N. simplex*, Serres (xliv, 39).

Shell composed of a discoidal portion and of two tubes; the last whorl recurved upon itself in the same way as *Anostoma*, in two tubes of variable length and less sinuous than the single tube of *Magilus*. (Fossil.) Relationships very doubtful.

FAMILY TRITONIDÆ.

Shell with varices, which are either few and irregularly disposed (*Triton*) or form a continuous row crossing the whorls on opposite sides (*Ranella*). The number of varices does not exceed two to each whorl, whilst in *Murex* the smallest number is three. Operculum annular, with subapical or central nucleus. Mantle enclosed, siphon straight, foot small. Lingual membrane with teeth in seven rows (3·1·3), like the *Doliidæ*, etc. (The *Muricidæ* have the teeth 1·1·1.) The dentition is illustrated on Plate xi, fig. 33.

Conchological reasons mainly induce me to place the *Tritonidæ* in close connection with the *Muricidæ*, rather than arrange them with the *Cassididæ* and *Doliidæ*, as indicated by their dentition.

The *Tritonidæ* first positively appeared in the eocene strata; the genus *Spinigera*, d'Orb., from the cretaceous, being now referred, more correctly I think, to the family *Strombidæ*, and *Trachytriton*, Meek, also cretaceous, does not belong certainly to the family.

TRITON, Montf.

Etym.—*Triton*, a sea-deity.

Syn.—*Tritonium*, Link. *Charonia*, Gistel. *Aquilus*, Montf. *Cabestana*, Bolt. *Lampusia*, Schum. *Ranularia*, Schum. *Colubraria*, Schum. *Linatella*, Gray. *Lotorium*, Montf.

Distr.—105 sp. Tropical seas, world-wide; low water to fifty fathoms. Fossil, 80 sp. Eocene—; Europe, Chili, etc. *T. variegatus*, Lam. (xlvi, 54).

Shell oblong; spire prominent, whorls with a few remote and non-continuous varices; columella rough or smooth; canal recurved, short or long; outer lip internally crenated or denticulated.

Operculum ovate, its growth annular either from a subapical or submarginal nucleus.

Whilst the lingual armature of *Triton* allies it closely with *Dolium*, etc., among the so-called tænioglossate mollusks, the affinities of the animal are on the whole closer, and those of the shell decidedly so, to *Muricidæ*. It may be considered a con-

necting link between the two groups, but certainly cannot be safely removed from the vicinity of the latter, to which it is not only allied by its operculum (which is entirely different from that of *Dolium*), but so closely by the shell in some instances, that the assignment of the generic position is quite arbitrary.

The Tritons are distinctly tropical in distribution, no species inhabiting the colder seas. The species are numerous and beautiful, presenting a great range of variation in size and color; one species being almost the largest of gastropod mollusks, attaining a length of one and one-half feet, whilst others, belonging to the *Epidromoid* section, do not exceed one-half inch in length. The cancelled forms are chiefly East Indian, and are dredged in sand in deep water; the West Coast of America species, covered with a rough epidermis, are obtained in sandy mud at from six to thirty fathoms depth. A number of species have a world-wide distribution, which is doubtless due to their free-swimming or pelagic larvæ. These, unlike the *Murices*, but like the *Purpuræ*, are very different at first from the adult both in animal and shell, undergoing a metamorphosis at a period subsequent to hatching.

I adopt the well-known name *Triton* in preference to the previously given *Tritonium* of Cuvier, believing that the interests of science are best conserved by keeping the nomenclature as stable as possible. *Triton* has been used in other departments of zoology, but so have many other generic names, which are nevertheless accepted without question.

Reeve says: "The Tritons are shells of much more solid structure than the *Murices* or *Ranellæ*, and of much more simple growth. They are not furnished with any spines nor have they any ramified branches like the *Murices*; the rude manner in which the whorls are convoluted seems rather to indicate that their animal inhabitant, though possessing abundant power of calcification, is of somewhat sluggish growth. The epidermis of *Triton* is often remarkably thick, hairy and bristly, and is sometimes accompanied with small tufts of bristles. Another curious peculiarity in these shells is the structure of the apex; it appears in numerous instances to be formed of horny substance, thinly plated with shelly matter, and it is not an uncommon thing to find examples in which the calcareous plating is worn off so as to expose the horny cast underneath. The columella of the Tritons is generally covered with a bright coat of wrinkled enamel, and the outer lip becomes thickened in a manner exceedingly curious; upon arriving at maturity the lip curls under so as to form a deep, broad channel or gutter, and this is then filled up to form the thickened lip. The varices are all constructed in the same manner, each forming for a time the margin of the aperture; they are destined, it is conjectured, to

protect the lip during a season of rest, and it would be extremely interesting if it could be discovered what length of time ordinarily elapses between the formation or deposit of the varix and the renewal of the operation of growth."—*Conch. Icon.*, vol. ii, Triton, 1844.

Mr. Arthur Adams mentions the adaptation of the Trumpet-shell (*T. tritonis*) to the purposes of a tea-kettle by the inhabitants of the Typinsan archipelago, near the Loo-Choo Islands; the operculum forming the lid, the canal answering the purpose of a spout, and the shell suspended by a wooden hook over the fire. Mr. Adams says that this rude vessel was adopted several times for the convenience of his party, and answered its purpose admirably.—*Narrative Voy. Samarang*, i, 89.

Madame Power found *T. nodiferus* capable of reproducing amputated tentacles, etc. The Silicians and Algerians eat this mollusk and esteem it a delicacy. At Nice, the fishermen and country people make a hole in the apex of the spire and use the shell as a trumpet which, Vérany remarks, produces a braying sound. It is an indispensable instrument in the old-fashioned charivari, which he describes as a deafening serenade to signalize the marriages of ill-assorted or unpopular couples.

The species of Triton being numerous, several attempts have been made to separate them into generic or subgeneric groups; the most successful being the arrangement of Messrs. H. and A. Adams. Two of these groups, however, *Simpulum* and *Cabestana*, are so closely related that I think Kobelt has very judiciously united them. *Priene* is the connecting form approximating Triton and *Ranella*; whilst in the latter genus species of the group *Lampas* recall Triton.

SIMPULUM, Klein. Shell fusiform, whorls nodosely ribbed; outer lip thick, plicate-dentate internally. Operculum with apical nucleus. *T. chlorostomus*, Lam. (xlvi, 55).

CYMATIUM, Bolten. Whorls triangular; aperture longer than the spire; outer lip dentated internally. Operculum with apical nucleus. *T. tigrinus*, Brod. (xlvi, 56).

GUTTURNIUM, Klein. Shell pyriform, subturreted, canal long, narrow. Operculum with submarginal initial point, near the middle of the inner margin. *T. cynocephalus*, Lam. (xlvi, 57).

The shells of this group possess a peculiar polished, porcelainous outer and inner lip, the latter reflected over the columella, together with a short, rounded pyriform body and lengthened, narrow, more or less twisted canal.

EPIDROMUS, Klein. Shell with long, generally curved spire; aperture small and canal very short. Operculum triangular, with submarginal nucleus. *T. distortus*, Schub. Wagn. (xlvi, 58).

PRIENE, H. and A. Ad. Shell ventricose, thin, cancellated or plicated; canal short. Operculum with apical initial point.

W. Coast So. America, northwards to Alaska; Japan. *T. scaber*, King (xlv, 59).

This small group contains shells of comparatively large size, thin, cancellate, white without any bands or spots of color, usually more or less covered by an epidermis; the operculum has a terminal initial point. The species inhabit a somewhat limited region, the West Coasts of South and North America, one of them recurring on the Japanese coast. The rarity of varices and general appearance of these shells indicate a passage into the Fusidæ, whilst they appear to connect more remotely with the *argus* group of *Ranella* and with *Buccinum*.

The distinctness of the following fossil groups is very doubtful.

RANELINA, Conrad. The group was never characterized. The type differs from the figure in the varices being partially disconnected, thus showing more affinity to *Triton* than to *Ranella*. *T. Maclurii*, Conrad (xlv, 60). Tertiary; Claiborne, Ala.

PERSONELLA, Conrad. Genus not characterized. Scarcely a *Distorsio*, but more like a *Gutturium*. *T. septemdentatus*, Gabb (xlv, 61). Eocene; Texas.

TRITONOPSIS, Conrad. The type is a water-worn specimen, which Prof. Angelo Heilprin, who has examined the shell, declares to be too imperfect to assign to it any reliable characters. Has some resemblance to the section *Cabestana*, like *T. doliarium*, L. *T. subalveatus*, Conrad (xlv, 62). Eocene; Vicksburg.

TRACHYTRITON, Meek. Its character appears to be confined to the occurrence of *internal* varices, marking the former positions of the lip, and which have not been absorbed when growth recommenced; otherwise very like *Priene Oregonensis* = *cancellatus*. The want of a callus on the upper part of the columella, which Meek makes a distinguishing character from *Priene*, also characterizes the *P. Oregonensis*, young, as described by Mr. Redfield. *T. vinculum*, Hall and Meek (xlv, 63). Cretaceous; Dakota.

DISTORSIO, Bolten.

Syn.—*Persona*, Montf.

Distr.—3 sp. Red Sea, China, Polynesia, W. Indies, W. Columbia. *D. cancellinus*, Roissy (xlv, 64).

Shell subturreted; whorls distorted; aperture irregular, contracted, ringent; canal recurved; inner lip dilated, lamellar, rugosely plicated; columella excavated, verrucosely plicate; outer lip sinuous, internally plicate-dentate.

This genus, in its ringent aperture, reminds one of the genus *Malea* in the *Doliidæ*.

RANELLA, Lam.

Etym.—*Rana*, a frog.

Syn.—Bufo, Montf. Bufonaria, Schum. Gyrinium, Link. Apollon, Montf. Bursa, Bolten. Semiranella, Gregorio.

Distr.—36 sp. Tropical seas, world-wide. Fossil, 23 sp. Eocene. *R. albivaricosa*, Reeve (xlv, 65). *R. spinosa*, Lam. (xlv, 66).

Shell ovate or oblong, compressed, with two rows of continuous varices, one on each side; aperture oval; columella arcuated and ridged, or crenulated; canal short, recurved; outer lip crenated.

The tentacles are commonly somewhat closer together than in Triton, and the head is longer and narrower than in Murex and Fusus; the eyes in some species are nearly basal, but are generally placed about the middle of the tentacles on their outer sides; the siphon is short and directed upwards; the foot larger than in Triton, Murex, or Fusus, and considerably dilated both before and behind; the mantle does not appear to be furnished with fimbriated processes as seen in some Murices. In some species the trunk is enormously developed, whilst in others it is not protruded, in the usual condition of the animal. Operculum ovate, horny, with a lateral nucleus and semicircular elements.

The species are inhabitants of warm seas, and principally tropical: those of the typical group having winged varices live in deep water, whilst the nodose species forming the subgenus Lampas, are found at less depth, and prefer coral reefs and rocks. The animal is active in its movements. Eupleura, formerly considered a subgeneric group of Ranella, is now classed with Muricinae, partly on account of the lingual dentition of one of its species.

I have retained the generic name Ranella, in preference to Bursa, Gyrinium, Bufo, Rana, etc., all of which have priority, but were obscurely published and have never attained general acceptance.

Mr. Macdonald thus describes the larval state of Ranella:

"I next observed a stout little shell, much resembling a Macgillivrayia in form, but having the spire more minute and sharply marked, and the whorls beset with epidermic spines, disposed in close spiral lines. The microscopic examination of the animal gave unmistakable proof of its being a Ranella, the lingual dentition agreeing, at least generically, with my figures and specimens. On examining the operculum, which in Ranella is so very remarkable, exhibiting three successive stages of growth, I found that it was quite of the same character, only that it had but yet attained the second stage. Finally, on comparing the whole operculum, and the little shell respectively, with the nucleus of the operculum and the apex of the shell of an adult Ranella, I could detect no points of difference, even with magnifying powers; the conclusion, therefore, is irresistible, that

the one is but the young state of the other."—*Linn. Trans.*, xxiii, 69.

Mr. Vélain remarks that *R. proditor* (= *R. argus*) is very plentiful at the Islands of Amsterdam and St. Paul, in the Indian Ocean, where the skeletons of seals, abandoned on the rocks at low-water by the fishermen, were literally covered with lobsters and *Ranellæ* at the succeeding tide. They are nocturnal in habit and may be readily fished by suspending over-night, in 10 or 15 mètres depth, the body of a bird or fish.

LAMPAS, Schum. (Colubraria, Schum. Crossata, Tutufa and Lampasopsis, Jousseaume.) Shell turreted; whorls nodose; aperture with posterior channel; canal very short and recurved. *R. bufonia*, Gmel. (xlvi, 67).

ASPA, H. and A. Adams. Shell ovate, ventricose, smooth; spire very short; whorls nodulous at the angles; aperture with posterior channel. *R. marginata*, Gmel. (xlvi, 68).

ARGOBUCCINUM, Klein. Spire elevated; canal short; posterior channel wanting. *R. pulchra*, Gray (xlvi, 69).

FAMILY FUSIDÆ.

Shell more or less spindle-shaped, without varices; the lip of the aperture not thickened.

Operculum ovate, acute, with apical nucleus.

The animal possesses the essential features of a *Murex*.

Dentition (x, 8). That of the typical genus *Fusus* does not differ essentially from *Fasciolaria*; Stimpson states (*Am. Jour. Conch.*, i, 54) that it has the saw-like lateral teeth of *Fasciolaria*, whilst Macdonald (*Ann. Mag. Nat. Hist.*, 4th ser., ii, 243) found another species to possess lateral teeth of the Muricoid type. Troschel finds a *Fasciolarioid* dentition in *Fusus Syracusanus*, and he has accordingly made for it a new genus, *Aptyxis*; but Schacko has recently found the same dentition in *Fusus inconstans*, Lischke, a typical *Fusus*. I think that Macdonald must have mistaken some other genus for *Fusus*. The dentition of *Sipho*, which, according to Troschel, resembles that of *Fasciolaria*, is shown by the more recent investigations of Sars to be Buccinoid. *Ptychatractus*, with evident resemblance to *Fasciolaria*, has a peculiar dentition, approaching *Murex*, and on this character alone Stimpson, followed by Gill, assigns to it a distinct family.

Neptunea, Melongena, etc., long classed with Fusidæ, are now brought into more intimate relationship with Buccinum, and Busycon, and Tudicla will go into the same group; on the other hand Peristernia, Latirus, etc., formerly included in Turbinellidæ, have a *Fasciolarioid* dentition, which, with added conchological characters, may suffice for their removal from that to the present

family. Stimpson (*Am. Jour. Conch.*, i, 60) describes and figures the dentition of an unknown species of *Peristernia* from the coast of Georgia, which has the essential features of *Busycon*, and he thereupon places the genus in *Neptuniinæ*; but it is evident that he was in error, as Troschel figures known species, which are *Fasciolariform* in dentition as they are in conchological characters.

Subfamily FUSINÆ. *Columella* not plicate, not tortuous.

Subfamily FASCIOLARIINÆ. *Columella* tortuous with oblique plaits or plications.

Subfamily PTYCHATRACTINÆ. Differs from *Fasciolarinæ* in lingual dentition, and includes only three small boreal species.

Subfamily PERISTERIINÆ. *Columella* with transverse plications.

SUBFAMILY FUSINÆ.

FUSUS, Lamarck.

Syn.—*Aptyxis*, Troschel. *Colus*, Humph. *Syrinx*, Bolt.

Distr.—65 sp. Tropical and Subtropical, world-wide. *F. Nicobaricus*, Lam. (xlvi, 70). Fossil, 300 sp. Bath oolite (?), Cretaceous to Eocene—.

Shell fusiform; spire long, acuminate, many-whorled; aperture oval, usually striate within; outer lip simple; columella smooth; no umbilicus; canal long and straight. Yellowish brown or light horn-color, sometimes with red-brown strigæ or spots; never banded. Operculum ovate, acute, with apical nucleus.

The genus, as restricted to the spindle-shaped forms, is subtropical in distribution—the northern species usually described as *Fusus* by the older conchologists being now more correctly referred to the family *Buccinidæ*.

COLUMBARIA, von Martens. Shoulder of whorls spinose, a revolving ridge on the lower part of body-whorl. Dentition similar to the *Pleurotomidæ*. *F. Pagoda*, Lesson (xlvi, 71).

SINISTRALIA, H. and A. Ad. Shell reversed, fusiform; canal long; whorls rounded. *F. Marocensis*, Gmel. (xlvi, 72).

HADRIANA, Bucq. and Dautz. Proposed for the European *F. craticulatus*, Brocchi, which unites the closed canal and varices of *Murex* with the simple lip and general form of *Fusus*.

EXILIFUSUS, Gabb. Shell very long, slender, fusiform; spire high; aperture produced into a long, slender, twisted canal.

This group differs from the true genus *Fusus*, as restricted, by its twisted, slender canal. In this character it approaches some of the *Neptunæ*, but its high spire and strongly costate whorls show that it is more nearly allied to the true *Fusus*. *F. Kerri*, Gabb (xlvi, 73). Cretaceous; N. Carolina.

EXILIA, Conrad. (*Exilifusus*, Conrad.) Shell very narrow, costate, spire subulate, canal long and narrow. *F. pergracilis*,

Conr. (xlvii, 74). Eocene; Alabama. Scarcely distinct from the typical Fusæ.

TURRISPIRA, Conrad. Has not been characterized, and does not seem to differ from Fusus. *F. Salebroso*, Conrad (xlvii, 75). Eocene; Alabama.

PRISCOFUSUS, Conrad. Founded on *Fusus geniculus*, Conrad, a very poorly preserved or figured fossil; the type has "been lost for twenty years. The species is wholly unrecognizable, and should be expunged from nomenclature. For this rubbish Mr. Conrad has proposed a genus Priscofusus, but with neither figure nor diagnosis."—DALY, *Proc. Calif. Acad.*, 1877. *F. geniculus*, Conrad (xlvii, 76). Eocene; Astoria, Oregon.

SERRIFUSUS, Meek. Shell short-fusiform; body-volution large, and bi- or tricarinate, with carinæ more or less nodose; spire and canal moderate, the latter bent and more or less twisted; outer lip broadly but slightly sinuous in outline, between the upper carina and the suture. *F. Dakotensis*, Meek and Hayden. Cretaceous; Dakotah.

This form so much resembles the recent *Fusus (Hemifusus) probosciferus*, Lam., that it might well be considered a fossil form of the same group.

JANIA, Bellardi. Shell subfusiform; spire elongate; mouth scarcely canaliculate behind; lip marginate, nodose or plicate within; columella uniplicate anteriorly and posteriorly; canal short recurved. *F. angulosus*, Brocchi (xlvii, 77). Tertiary; Italy.

MAYERIA, Bellardi. Ovate-fusiform, spire short, but slightly acute; whorls very sharply carinate in the middle; columella smooth, rather straight in front, canal moderate. *F. acutissimus*, Bellardi (xlvii, 81). Tertiary; Italy.

ANURA, Bellardi. Shell turreted, ovate ventricose; whorls convex; mouth orbicular or suborbicular; lip somewhat arcuate, exteriorly subvaricose in the adult, interiorly margined and smooth; canal scarcely produced; columella slightly contorted, smooth. *F. inflatus*, Brocchi (xlvii, 79). Tertiary; Italy.

MITRÆFUSUS, Bellardi. Elongated, mitræform; spire very long and acute; whorls numerous, the last scarcely depressed in front; mouth narrow, long; lip simple; canal long, produced in the axis of the shell. *F. orbitus*, Bell. et Mich. (xlvii, 80). Tertiary; Italy.

GENEA, Bellardi. Shell subfusiform, long, narrow; spire long, very acute; mouth long, narrow; lip simple; columella smooth, but slightly arcuate; canal very short, wide, straight. *F. Bonellii*, Gené (xlvii, 78). Tertiary; Italy.

AFER, Conrad.

Distr.—2 sp. Red Sea to Manilla, Senegal. *A. Blossvillei*, Desh. (xlvii, 82).

Shell short fusiform, spire and canal moderate, body-whorl rather large, shouldered and tuberculate, aperture channeled behind, outer lip dentate within.

Professor Meek (Pal. Hayden's Survey., ix, 344) states that the fossil species described by Conrad, are not congeneric with the type, the recent *Fusus afer*, Lam., and he refers them to Conrad's genus *Pyrifusus*, one of the forms of *Neptuniinæ*.

CLAVELLA, Swainson.

Syn.—*Clavellithes*, Swn. *Cyrtulus*, Hinds. *Triumphis*, Gray. *Peistocheilus*, Meek.

Distr.—*C. serotina*, Hds. (xlvii, 83). Marquesas Is. Fossil. Cretaceous; Missouri.

Shell solid, thick, subfusiform; spire acuminate; last whorl suddenly contracted in front, thickened and rounded next the suture; aperture narrow, canal long and straight; columella excavated in the middle; outer lip simple. Operculum ovate; nucleus apical. Dentition, unknown.

Only one recent species can be referred properly to this fossil genus, which is the *C. serotina*, the type of Hinds' genus *Cyrtulus*. The three other recent species referred to it by H. and A. Adams are members of other genera: *C. avellana*, Reeve, is a *Cronia*. *C. distorta*, Reeve, belongs to the *Pisaniinæ*. *C. subrostrata*, Gray, belongs to the *Melongeniinæ*.

Peistocheilus, Meek, described as a subgenus of *Fasciolaria*, appears to be identical with *Clavella*, as Meek himself subsequently suspected. The columellar plaits are nearly obsolete, situated so far within the aperture as to be barely visible and in many specimens are not seen at all. *C. Scarboroughi*, Meek and Hayden (xlviii, 1, 2). *Clavella* itself occasionally shows these adventitious and inconspicuous plaits. The shell is so decidedly fusiform that I place it in the *Fusinæ* in preference to the *Fascioliariinæ* despite these folds.

BUCCINOFUSUS, Conrad.

Syn.—*Boreofusus*, Sars. *Troschelia*, Mörch, 1876.

Distr.—2 sp. North Sea, Spitzbergen. *B. Berniciensis*, King (xlvii, 84). Fossil. Miocene; U. S.

Shell ventricose, spirally sculptured; epidermis pilose; spire produced; canal moderate in length; columella smooth. The type of this genus is a Miocene fossil, *B. parilis*, Conr.

The dentition, only, separates this from *Sipho*, several species of which might be regarded as either indetical, or varieties at most.

Jeffreys thus describes the animal: Body white or cream-color, with a slight tinge of flesh-color; mantle sometimes edged with brown; pallial tube extensile, occasionally protruded beyond the

canal, with an expanded or trumpet-shaped opening; proboscis exceedingly long, measuring nearly two inches even when contracted after the death of the animal; tentacles conical, rather short, and close together, with bluntly pointed tips; eyes small and black, seated on long stalks, about half-way up the tentacles; foot lanceolate, thick, rounded and double-edged in front; tail either pointed or blunt and somewhat truncated.

SUBFAMILY *FASCIOLARIINÆ*.

FASCIOLARIA, Lam.

Etym.—*Fasciola*, a band. *Syn.*—*Ioceranea*, Raf.

Distr.—14 sp. Tropical and Subtropical, world-wide. *F. distans*, Lam. (xlvi, 85). *F. aurantiaca*, Lam. (xlvi, 86). Fossil, 30 sp. U. Cretaceous—.

Shell fusiform; spire acuminate; aperture oval, elongated; canal open, moderate in length, nearly straight; columella smooth, with a few oblique plaits at the fore-part; outer lip internally crenate.

The animal of *Fasciolaria* does not differ essentially from that of *Fusus*, nor do we find very much difference in the shells; the usually shorter spire, more swollen body-whorl, wider and shorter and flexuous instead of straight canal, and the oblique plaits near the fore-end of the columella, are the chief distinguishing characters. Between *Fasciolaria* and *Fulgur* the resemblance is much closer, and, until the dentition of the two groups became known, they were placed close together by systematists; in *Fulgur*, however, the scarcely apparent folding of the columella is single, whilst in *Fasciolaria* it is double, sometimes triple. The *Peristerniinae* have columellar folds, but these are usually more transverse, are situated higher on the columella, and the shells are much smaller; indeed one of the characteristics of the *Fasciolarias* is the comparatively large size of the species, *F. gigantea*, of the southern Atlantic coast of the United States, attaining a length of nearly two feet—the largest of gastropods. The distribution of the genus is tropical and subtropical, in shallow waters. But few living species are known, to which may be added some fossil forms, commencing with the cretaceous. The operculum is more claw-shaped than that of *Fusus*, and is rather large, filling the aperture.

I have figured the nuchal capsules of *F. tulipa*, Linn. (xvii, 7).

TEREBRISPIRA, Conrad. Shell of medium size, with spire much produced and canal short; volutions convex, angular, and strongly spirally ridged; plaits of columella not exposed externally; outer lip internally sulcated. *F. elegans*, Emmons (xlvi, 87). Miocene; Alabama.

MESORHYTIS, Meek. Shell agreeing nearly with *Peistocheilus* in form, but with plaits of columella stronger, comparatively little oblique, and exposed directly opposite the middle of the aperture; surface with fine spiral striae, and vertical costae. *F. gracilenta*, Meek (xlvi, 88). Cretaceous; Yellowstone River, 150 miles from its mouth. Has the folds of a *Mitra*, rather than a *Fasciolaria*, and Meek refers it with considerable doubt to its present position.

CRYPTORHYTIS, Meek. Shell generally under medium size, with volutions convex, but constricted above, and provided with regular vertical costae or small folds; plaits of the columella very oblique, not exposed in a direct view into the aperture, and occupying a higher position than in the typical group; outer lip smooth within. *F. Cheyennensis*, Meek and Hayden (xlvi, 89, from a cast). Cretaceous; Dakotah.

LIROSOMA, Conrad. Subpyriform; ribbed, beak narrow and produced, slightly recurved; one long, very oblique plait at the angle of the columella. *F. sulcosa*, Conrad (xlvi, 90). Miocene; Maryland.

FASCIOLINA, Conrad. Fusiform; columella nearly straight to the extremity of the beak; one prominent oblique fold on the columella, situated above the middle of the aperture. *F. Woodii*, Gabb. Miocene; New Jersey. The only figure does not exhibit the aperture, but Conrad states that the fold is situated more remote from the beak than in any other genus except *Cuma*.

SUBFAMILY PTYCHATRACTINÆ.

This group was distinguished as a family by Stimpson. The shell of *Ptychatractus* unites the form of a *Sipho* with the folds of a *Fasciolaria*; its small size, color, and northern habitat will distinguish it from the latter, even without taking into account the very diverse dentition; yet without the latter difference it would scarcely have been advisable to have separated the single species upon which the genus was founded from *Fasciolaria*.

PTYCHATRACTUS, Stimpson, 1865.

Distr.—3 sp. Boreal Atlantic and Pacific. *P. ligatus*, Mighels and Ads. (xlvi, 91).

Shell fusiform, spirally striated; aperture with a moderate canal; columella plicated as in *Fasciolaria*.

MEYERIA, Dunker and Metzger.

Syn.—*Metzgeria*, Norman.

Distr.—*M. alba*, Jeffreys (xlvi, 92). Faroë Is., North Sea, Norway.

Shell elongate-fusiform, longitudinally obtusely plicate; spire

produced; canal exerted; columella obscurely plicate. Operculum irregularly ovate; apex obtuse; nucleus inconspicuous.

The dentition of this mollusk appears to relate it somewhat to Ptychatractus, and I prefer to place it in the same subfamily with that shell, rather than make a new family for it. Norman shows that Meyeria is preoccupied by M'Coy for a genus of fossil crustaceans, and he therefore proposes the generic name Metzgeria; but I see no advantage (and much disadvantage) in changing names because they happen to have been previously used in some other department of zoology.

SUBFAMILY PERISTERIINÆ.

PERISTERIA, Mörch.

. *Distr.*—30 sp. Polynesia, Philippines, Australia, Indian Ocean, Zanzibar, Mauritius. *P. nassatula*, Lam. (xlviii, 93). *P. incarnata*, Desh., var. (xlviii, 94). *P. Belcheri*, Rve. (xlviii, 96).

Shell turreted, not umbilicated; whorls longitudinally ribbed; aperture oval; canal moderate and recurved; outer lip thin and crenulated; columella with one or two slight plaits anteriorly. The want of umbilicus, less distinct columella folds and recurved canal are the principal (and not sufficient) distinction from *Latirus*.

LATIRUS, Montfort.

Syn.—Chascax, Watson. Polygona, Schum., 1817. Plicatella, Swains.

Distr.—34 sp. Polynesia, Philippines, Australia, Indian Ocean, Panama, W. Indies, Madeira. *L. infundibulum*, Gmel. (xlviii, 95).

Shell turreted, fusiform, sometimes umbilicated; spire produced; whorls nodulous, aperture oval-oblong; outer lip thin, crenulated; columella straight, with two or three small oblique plaits in front. Mr. H. Crosse remarks upon the insufficiency of the diagnosis of *Latirus* by Montfort and H. and A. Adams, and proposes to relegate the species to *Turbinella*; that genus, however, may be more advantageously restricted to the forms for which the genera *Vasum* and *Mazza* have been constituted.

Swainson's group *Plicatella* has been adopted by Messrs. Adams as a subgenus of *Latirus*, having "spire moderate, whorls angular, concavely depressed around the upper part," but these are only comparative characters, and I prefer to suppress the group rather than place in it species having no relation thereto, as Messrs. Adams have done. The umbilicus shows more distinctly in most of the species of *Latirus* than in those of *Peristernia*, but in some of them it is not any better marked; *Latirus*, however, differs in form from *Peristernia*, the species having longer spire and canal, the columella generally straight,

the plications more central, simply because the canal is more produced.

The animals of most of the species that have been observed are of a dull red color.

LEUCOZONIA, Gray.

Distr.—9 sp. W. Africa, W. Indies, Panama. *L. cingulata*, Lam. (xlvi, 97).

Shell oval, subglobose, shouldered; spire moderate; aperture oblong; canal short; columella subflexuous, with small oblique, unequal plaits; outer lip subacute, with a more or less prominent tooth or tubercle at the fore-part.

The most prominent character of this genus, when present, is the tooth which arises from the fore-part of the outer lip. It varies greatly in its development in the different species. In *L. cingulata*, in which it is always present, it is long, curved and tusk-like, so that the species has been erroneously arranged with *Monoceros*, from which it is instantly distinguished by its claw-like operculum and columellar plaits. In the other species it is sometimes entirely absent in some specimens, whilst well developed in others. There is usually a posterior subchannel to the aperture. The sculpture does not vary essentially from that of the species of *Latirus*, but the color is usually a chestnut-brown, the only ornamentation being lighter or darker revolving bands. Usually the species are prominently shouldered.

LAGENA, Schum., 1817. Whorls rounded above, not shouldered. *L. smaragdula*, Linn. (xlvi, 98).

Genus *MAZZALINA*, Conrad, appears to be very similar to *Lagena*, Schum., if not identical with it. *M. pyrula*, Conrad (xlvi, 100). Eocene; Alabama.

FAMILY BUCCINIDÆ.

Shell ovate, oblong or pear-shaped; canal moderate or short, columella without folds or plications.

Operculum with terminal or lateral nucleus.

Dentition 1·1·1. The rhachidian tooth normally three- (sometimes as many as seven-) pronged, the laterals two- or three-pronged (x, 11, 12).

The typical *Buccinum* is a rather thin ovate shell, uniform and dull in color, with the base of the aperture broadly notched instead of being prolonged (as in *Fusidæ*) into a canal; but with these have been more recently associated pyriform shells having some resemblance to the latter family. *Hemifusus*, *Melongena*, *Sipho*, etc., pretty well bridge the chasm between the two families as far as the general form of the shell is concerned, but in those species of *Buccinidæ* approaching *Fusus* there is the general distinction that the canal, if long, is wide and open;

whilst tortuous as in *Fasciolaria*, it has at most a single fold in lieu of the plaits on the columella of that genus. I have arranged the subfamilies and genera, commencing with those most closely allied to *Fusus*, and terminating with the truly buccinoid forms. Although the range of form is great, it will be seen that the transitions are not abrupt; and in this case the lingual dentition affords confirmation of the grouping adopted upon conchological grounds.

Subfamily MELONGENINÆ. Shell pear-shaped, heavy; spire and canal short.

Subfamily NEPTUNIINÆ. Shell rather thin, pear-shaped or ovate; canal moderate and twisted.

Subfamily PISANIINÆ. Shell small, heavy, costate; canal very short and wide, outer lip thickened, dentate within; columella callous or rugose.

Subfamily BUCCININÆ. Shell rather thin, costate or smooth, ovate, covered with a horny epidermis; aperture very large, lip thin, smooth within, terminating below in a short oblique notch.

Subfamily EBURNINÆ. Shell thick, smooth, ovate-oblong; deeply umbilicated or umbilicus covered by a heavy callus; outer lip simple acute.

Subfamily PHOTINÆ. Shell small, smooth, costate or cancellate, ovate or turreted, thick; outer lip striate within; canal short and wide, columella twisted below.

SUBFAMILY MELONGENIINÆ.

MELONGENA, Schum.

Syn.—*Cassidulus*, Ads. *Galeodes*, Bolt. *Mancinella*, Mus. Berl. *Myristica*, Swin. *Pugilina*, Schum. *Volema*, Bolt.

Distr.—11 sp. West Indies, Panama, Red Sea, Philippines, Australia, Polynesia. *M. corona*, Gmel. (xlix, 3).

Shell pyriform, solid, dark-colored or banded; spire short, nodulose, spiny; aperture oval-oblong; canal short, open; columella smooth; outer lip simple. Operculum solid, claw-like, nucleus apical.

Kobelt, in his monograph of *Pyrula* (*Conchylien Cabinet*), adopts that genus, taking as subgenera *Cassidulus* (= *Melongena*), *Myristica*, *Pugilina*, *Volema* and *Hemifusus*. These groups which (except the last) are too closely related conchologically as well as by their lingual dentition, Troschel also places together, but without subordinating them to a higher group. *Pyrula* would, indeed, be an excellent name on account of its acceptance years ago for the major part of the species, but unfortunately the first and only species cited by Lamarck in his original description of the genus is the *Bulla ficus*, Linn., which

is a member of the genus *Ficula*, Swainson, over which it has priority, and instead of which it should therefore be adopted. *Cassidulus*, Humphrey, has priority over *Melongena*, but I cannot adopt it as it is a mere catalogue name.

BULBIFUSUS, Conrad. Not characterized. *M. inauratus*, Conr. (= *Fusus Fittonii*, Lea) (li, 49). Eocene; Claiborne, Ala.

CORNULINA, Conr. Not characterized. *M. armigera*, Conr. (= *Fusus Taitii*, Lea) (li, 48). Eocene.

LEIOSTOMA, Swains, 1840. (*Sycum*, Bayle, 1880.) Fusiform, ventricose in the middle, entirely smooth, almost polished; inner lip thickened and vitreous; base of the pillar very straight. *M. bulbiformis*, Lam. (li, 49). Grignon.

A comparison of numerous specimens indicates the very close relationship of *Bulbifusus*, Conr., with this group. Bayle has changed the name to *Sycum*, because *Leiostoma* is preoccupied by Lacépède in Fishes. I cannot concur in such changes, which would completely unsettle our nomenclature.

HEMIFUSUS, Swainson, 1840.

Syn.—*Cochlidium*, Gray.

Distr.—6 sp. W. Coast Africa, West Indies, Peru, Philippines, Australia, Indian Ocean.

Shell subfusiform, uncolored or light yellowish; spire shorter than the aperture, ponderous; whorls armed with compressed spines upon the shoulder; aperture long ovate, with an ascending internal canal at the hind-part, produced into a moderate wide canal anteriorly; columella smooth; outer lip simple. Operculum unknown.

Besides being thinner, the shells of this genus are distinguished from *Melongena*, by being white (without bands or other color-markings) under a light yellowish brown epidermis. They differ from *Fusus* in the flexuous, wider, open canal, which is widened gradually into the lower portion of the aperture.

THATCHERIA, Angas. Shell angularly pyriform, solid; spire prominent, shorter than the aperture, many-whorled, whorls flattened above, strongly keeled at the periphery and contracted below; aperture with a broad incurved sinus between the extremity of the last keel and the junction of the body-whorl; basal canal wide and open; columella smooth; outer lip simple below the sinus. *T. mirabilis*, Angas (xlix, 5).

That this shell is a scalariform monstrosity cannot be doubted, but what may be its normal form is not so readily ascertained. I saw the single specimen from which the above generic description was made, in London, in 1877, and was immediately convinced that the conical form, flattened shoulders and sinus were all due to distorted growth.

SUBFAMILY NEPTUNIINÆ.

NEPTUNEA, Bolten.

Syn.—Chrysodomus, Swains., 1840.

Distr.—18 sp. Circumpolar, Pacific and Atlantic, Europe, Asia, America. *N. antiqua*, Linn. (xlix, 6). *N. decemcostata*, Say (xlix, 7).

Shell fusiform, ventricose; spire elevated, whorls rounded, covered with a horny epidermis, apex papillary; aperture oval; canal short; inner lip simple, smooth. Operculum ovate, nucleus apical.

The shells of this genus are boreal in distribution, and like the other circumpolar genera, are nearly destitute of color, being white or yellowish, under a light brown or yellowish, rather smooth epidermis. The sculpture, when there is any, consists of revolving striæ, ridges or ribs, and the lip of the aperture is smooth within or merely modified by the external sculpture when the shell is thin. In the genus *Siphonalia*, the species of which are mainly Japanese and Australian, the general form is similar, but the shell is nodose, frequently developing longitudinal ribs, and the outer lip is more disposed to be crenulate; the surface is more usually ornamented with color, disposed in bands, etc. There are some species which can be only arbitrarily placed, having characters partaking of either genus; and in fact geographical considerations must sometimes be allowed considerable weight in assigning such species to their respective genera.

Some of the species are apparently very variable, and it is difficult to decide whether the conservative views of Gwyn Jeffreys and Kobelt, or the more extreme views of Mörch, etc., are most in accordance with truth.

Of *Neptunea antiqua* (xlix, 6), Mr. J. Gwyn Jeffreys (*Brit. Conch.*, iv, 326) says:

"This is good bait for codfish, and a favorite delicacy of the lower working-classes in London. At Billingsgate it is sold under the name of 'almond' or 'red whelk;' according to Rutly's History of Dublin the Irish call it 'barnagh,' the tail (liver) being said to be more fat and tender than a lobster. The egg-cases or capsules overlap one another in an imbricated fashion, each being firmly attached by its base to the underlying capsule; they are deposited in clusters of from a dozen to a hundred, the capsules in each cluster being equal in size. Those which compose one cluster, however, are not half as large as those forming another cluster, although in both cases the fry are in the same state of maturity. When they are dry, the upper or convex side shrivels, and is wrinkled or pitted; the under or flat side (which by contraction becomes concave) is of a silky texture, and divided

across by a few lines; the opening is a wide slit, lying just under the top which makes a narrow flap.

"Before leaving the capsule the fry are perfectly formed, with conspicuous tentacles, eyes, and operculum; their shell has two whorls, the first being smooth, and the other showing a few slight incipient striæ. Each capsule produces only from two to four fry. The latter end of winter appears to be the spawning-season; on the 26th of January, 1861, I examined fresh capsules which contained merely eggs immersed in a glairy liquid; and seven days afterwards I found in the other capsules full-sized and living young whelks."

JUMALA, Friele, 1882. (*Chrysodomus*, in part.) Central plate small, quadrangular, unarmed, laterals hooked, with two small teeth on the inner margin. *N. Turtoni*, Bean. The dentition forms an insufficient distinction of this group from the typical Neptuneæ.

VOLUTOPSIS, Mörch. (*Syn.*—*Strombella*, Gray.) Shell smooth, ovate, ventricose; spire short, apex bulbaceous; last whorl rather large; aperture very large, the lip considerably expanded; canal scarcely produced, widely obliquely truncate. Operculum irregularly ovate, with apical nucleus. *N. Norvegica*, Chemn. (xlix, 8).

The shells of this division are characterized by their large mouths, expanded lips, want of distinctly produced canal, etc. The small operculum is (in *V. Norvegica*) more ovate than in the true Neptuneæ; the dentition also, varies from the typical form. *Volutopsis* appears to stand between *Neptunea* and *Buccinum*.

HELIOTROPIS, Dall. (*Pyrulofusus*, Beck.) Shell thin, sinistral, apex mammillated. Operculum relatively very small.

The essential character of this group is the reversed direction of the spire, placing the aperture on the left instead of the right side of the shell. The principal species have been considered by good conchologists as mere monstrosities of dextral species; thus Mr. J. Gwyn Jeffreys regards *N. contraria*, Linn. (xlix, 9) as equivalent to *N. antiqua*. But of this species it has been shown that it has an extensive distribution in Southern Europe, where the normal *N. antiqua* is unknown, and that the so-called reversed *antiqua* is very rare where the normal form is abundant.

SIPHO, Klein.

Syn.—*Atractus*, Agassiz. *Tritonofusus*, Beck.

Distr.—37 sp. Arctic and Boreal, Atlantic and Pacific, Europe, Asia and America. *S. ventricosus*, Gray (xlix, 10).

Shell thin, pyriform or fusiform, not tuberculate or spiny, usually smooth and rounded whorls; spire moderate; canal produced and recurved. Operculum ovate, nucleus apical.

Mr. Gwyn Jeffreys thus describes the egg-capsules of *S. gracilis*, DaCosta :

"The capsules are solitary, small, membranous, pouch-shaped, and attached by a broad base to stones and corallines; their surface is microscopically and closely reticulated; orifice extremely large and sometimes having the edge partly stained with pink. Each capsule contains only a single embryonic shell, which is transparent, and through it may be seen the orange liver and two unequal-sized plumes of pale yellow gills."

NEPTUNELLA, Verrill. Founded on the peculiarly velvety epidermis and the dentition of *S. pygmæus*. The epidermis is, however, no more velvety than in some other species, and the description of the dentition given by Verrill applies very well to that of *Sipho Islandicus*.

SIPHONORBIS, Mörch. Apex depressed, embryonic whorls gradually diminishing, angigyrus. In the true *Siphos* the apex is mamillary. *S. ebur*, Mörch.

MOHNIA, Friele. Operculum paucispiral. *M. Mohnii*, Friele (xlix, 11, 12).

SIPHONALIA, A. Adams.

Distr.—25 sp. Japan, California, Australia, N. Zealand. *S. Tasmaniensis*, Angas (xlix, 13. *S. nodosa*, Mart. (xlix, 14).

Shell ovately fusiform, sometimes variegated in coloring, rather thin, epidermis very thin, fugaceous; last whorl ventricose, shouldered, usually nodosely plicate and spirally ribbed; aperture oval, outer lip thin, columella smooth; canal rather short, twisted. Operculum ovate, nucleus apical. Dentition unknown.

This genus is principally of tropical and subtropical distribution, and more highly colored than *Neptunea*: which, nevertheless, it approaches very nearly in the form and color of *S. Kellettii*, for instance. The metropolis of the genus is Japan, a few forms being found, however, on the opposite shores of the West Coast of North America; some species occur also in Australian waters. The shells are usually thin and ventricose, variegated in color and destitute of epidermis. The operculum is fusoid.

AUSTROFUSUS, Kobelt. Shell ovate-fusiform, whorls rounded, not angulated at the upper part. *S. alternata*, Phil. (xlix, 15).

FULGUR, Montfort.

Syn.—Busycon, Bolt.

Distr.—5 sp. Atlantic Coast of United States. *F. carica*, Gmel. (xlix, 16). Fossil. Tertiary; Eastern U. S.

Pear-shaped, thin; spire short, the angle of the shoulder spinous; body-whorl very large, attenuated below into a rather long twisted canal; lip and columella smooth, the latter with a single, rather obsolete fold. Operculum ovate, nucleus apical.

Dentition of typical form; rhachidian tooth 5-6 dentate, laterals 5-6 dentate.

Animal rather small, retractile with its operculum within the shell for about a third of a volution from the aperture.

The distribution of the genus is restricted to the temperate and subtropical waters of the Atlantic Coast of the United States, and its manifest conchological position connects *Fasciolaria* with *Neptunea*. It is not infrequent in our miocene deposits, from which several species have been described by Mr. Conrad.

The name *Fulgur*, meaning lightning, is in allusion to the somewhat tortuous longitudinal brown streaks upon the shells (of Southern specimens), indicating rest-periods in its growth. The animal is used for bait by fishermen, and the trade in the shells for garden ornaments and for use as hanging flower-pots is so extensive as to have nearly caused the extermination of the species upon portions of the New Jersey coast.

Mörch and Adams have used the name *Busycon*, of Bolten, for this genus, but Bolten did not characterize it, whilst the later name given by Montfort accompanies a full generic description; I therefore prefer *Fulgur*. It was included by Lamarck in the heterogeneous assemblage of species which he called *Pyrula*.

The late Dr. Jeffreys Wyman, in his valuable memoir on the "Fresh-Water Shell Mounds of the St. John's River, Florida," mentions two kinds of chisel-shaped tools cut from the shells of *Fulgur carica* and *F. perversa*. These implements were probably used by the aborigines for fleshing skins and for the manufacture of articles of wood. *F. perversa* was also used by the Florida Indians as a drinking vessel, the interior whorls being removed to increase its capacity. This same species was extensively used and must have been an important article of trade among the natives, as it is frequently found in Indian graves and mounds throughout the Southern and Western States and Canada. It is probable that, among other uses, it was cut up into beads and various small ornaments. The white kind of wampum or shell money of the Indians was partially made of the axis of the shells of *Fulgur*, and partially from *Buccinum undatum*.

SYCORYPUS (Browne), Gill. Shell with canaliculate suture, periostraca ciliated, nodulous instead of spinous. *F. canaliculatus*; Say (xlix, 17, 18).

I do not consider Browne's description sufficiently characteristic to meet the requirements of a diagnosis; moreover, these shells are known not to inhabit Jamaica. Gill's diagnosis is, of course, accurate, but it mainly repeats the characters of *Fulgur*; the real difference is in the canaliculated sutures and ciliated

periostracum. The distinction of "spinous" for *Busycon* or *Fulgur*, and "tuberculated" for *Sycotypus* is of little importance generically, as the *Fulgurs* are frequently only tuberculate when young and become spinous with advancing age; moreover, the miocene series serve to connect the two groups in this respect. Under these circumstances I judge it better to make *Sycotypus* a subgenus only, under *Fulgur*.

Mr. T. A. Conrad (*Am. Jour. Conch.*, iii, 182) attempts to distinguish the embryos of *Sycotypus* from those of *Fulgur* by the latter having a long fissure parallel with the columella, whilst the columellar region of the former is entire. Mr. Conrad's specimens, which are before me, and which I saw him extract from the pouches, certainly show this difference, but I have since had occasion to examine the embryos of *Fulgur* several times, and from different strings of pouches, *none* of which show the slit columella; the character was probably pathological.

TAPHON, H. and A. Adams. Shell dextral, transversely striated, whorls rounded; aperture ovate, fore-part produced into a long, slightly recurved canal. *F. striatus*, Gray (xlix, 19).

SYCORPIS, Conrad. Shell tuberculate, not canaliculate. Eocene and Miocene. Differs from the genus in having tubercles instead of spines on the shoulder.

STREPTOSIPHON, Gill.

Distr.—*S. porphyrostoma*, Ads. and Reeve (xlix, 50). Eastern Seas, Senegal.

Shell subfusiform; spire rather short, apex papillary; whorls angulated at the upper part and tuberculate on the angle; columella concave, with a double very oblique fold on the lower part; canal moderately long, twisted; aperture lirate within. Operculum and animal unknown. Seems to connect *Busycon* with *Tudicla*.

TUDICLA, Bolten.

Syn.—*Spirilla*, Humph. *Pyrella*, Swin.

Distr.—5 sp. Indian Ocean, China, Australia. *T. inermis*, Sowb. (xlix, 21).

Shell fusiform; spire short, apex papillary; aperture oval; canal very long, narrow, straight; columella smooth, flattened, with a single large, or three smaller transverse folds at the fore-part. Operculum fusoid. Dentition unknown.

PAPILLINA, Conrad. Pyriform; shoulder angular and spinous; beak long, with an obtuse fold on the columella; three volutions from the apex forming a papillated summit. *P. papillatus*, Conrad (li, 58). Eocene; Claiborne, Ala.

PERISSOLAX, Gabb. Spire depressed; body-whorl patulous; canal long; columella without folds or plaits. Distinguished from *Papillina* by the want of a columellar fold, and evidently

intended to be ranged in the Fusinæ, but I think its general appearance decidedly that of Busycon or Tudicla. Cretaceous to Eocene. *P. brevirostris*, Gabb (li, 59). Cretaceous; California.

LEVIFUSUS, Conrad, is generally considered synonymous with Perissolax. It is an uncharacterized Eocene form. *P. trabeatus*, Conr. Eocene; Alabama.

FUSISPIRA, Hall.

Distr.—*F. ventricosa*, Hall (li, 50). Trenton Limestone, near Green Bay. So far as known, this palæozoic genus is confined to the Quebec, Trenton and Hudson River groups.

Shell fusiform, imperforate, spire more or less elevated, with rounded volutions; aperture elongate, oval or elliptical, produced below, forming a subrimate canal; columella slightly twisted, without folds, peristome sharp. Surface smooth.

CLOSTERISCUS, Meek.

Distr.—*C. tenuilineatus*, Meek (li, 51). Cretaceous; Cheyenne Riv., Dakotah.

Shell thin, fusiform; spire slender, longer than aperture and canal; surface smooth or minutely striate; aperture rhombic, outer lip broadly retreating above the middle, thin, excepting at irregular intervals, where it became thickened and denticulate within, so as to leave internal varices behind as the shell advanced in growth; inner lip very thin, or wanting; columella smooth (?).

PALÆATRACTUS, Gabb.

Distr.—*P. crassus*, Gabb (li, 52). Cretaceous; California.

Pyriform, thick; spire low; columella slightly twisted; outer lip simple, inner lip incrustated. Surface heavily ribbed or cancellate.

PYRIFUSUS, Conrad.

Distr.—*P. subdensatus*, Conr. (li, 53). Cretaceous; Mississippi.

Pyriform; columella broad, thick, flattened; body-volution transversely oval, compressed dorso-ventrally.

NEPTUNELLA, Meek. Body-volution rounded; columella not flattened; spire more elevated; outer lip broadly sinuous above the middle. *P. Newberryi*, Meek and Hayden (li, 54). Cretaceous; Dakotah.

HERCORHYNCUS, Conrad.

Distr.—*H. Tippiana*, Conr. (li, 55). Cretaceous; Mississippi.

Shell fusiform; spire prominent, scalariform, longitudinally ribbed and tuberculated, or with tubercles only; top depressed above the angle or shoulder of the last whorl, which depression becomes angular at the aperture, emarginating the upper part of the labrum; last whorl broad and rather abruptly rounded at base; beak abruptly recurved and produced.

LIROFUSUS, Conr.

Distr.—*L. thoracicus*, Conr. = *ducussatus*, Lea (li, 56). Eocene; Alabama.

Genus not characterized.

STREPSIDURA, Swainson.

Distr.—*S. costata*, Swainson = *Fusus ficulneus*, Lam. (li, 57).

Widely fusiform; basal portion of the pillar turned outwardly, with a sharp fold at the base of the aperture; shell costate and subearinate, body-whorl ventricose.

TORTIFUSUS, Conrad.

Syn.—*Meganema*, Conr.

Distr.—*T. curvirostra*, Conr. (li, 60). Miocene; N. Carolina.

Differs from *Busycon* in being without a trace of tubercles or spines, and in having prominent regular ribs; the whorls are flattened on top, and slightly canaliculated.

PYROPSIS, Conrad.

Distr.—*P. perlata*, Conr. (li, 61). Cretaceous; Tippah Co., Miss.

Spire very short, apex not papillated; labrum without striæ within, thick; columella without a fold.

CLAVIFUSUS, Conrad.

Distr.—*C. Cooperi*, Conrad (li, 62). Eocene; Alabama.

The genus has not been characterized.

SUBFAMILY PISANIINÆ.

PISANIA, Bivona.

Syn.—*Pusio*, Gray.

Distr.—20 sp. West Indies, Mediterranean, Red Sea, Philippines, Australia, Polynesia. *P. pusio*, Linn. (l, 22).

Shell oblong; spire prominent, whorls smooth or spirally striated; canal very short; outer lip thickened and crenated. Operculum ovate, nucleus apical.

Between typical specimens of this genus and of *Euthria* "there is a distinction with a difference," and therefore it may be profitable to retain both groups; but there are species in which the characters become so merged that their generic classification is merely arbitrary.

EUTHRIA, Gray.

Syn.—*Evarne*, H. and A. Adams.

Distr.—10 sp. Mediterranean, Cape, N. Zealand, Cape Horn, Chili, California, Alaska, Japan. *E. cornea*, Linn. (l, 23).

Shell fusiform, smooth; aperture oval, produced anteriorly

into a long recurved canal; inner lip simple; outer lip posteriorly sinuated, striate within. Operculum ovate, nucleus apical.

METULA, H. and A. Adams.

Distr.—4 sp. N. Zealand, Japan. *M. clathrata*, Ads. and Rve. (1, 24).

Shell elongately fusiform, finely cancellated; spire elevated, acute; aperture narrow; inner lip distinct, smooth; outer lip thickened externally, crenulated within, emarginate posteriorly. Operculum unknown.

CANTHARUS, Bolten.

Syn.—Pollia, Gray. Tritonidea, Swn.

Distr.—55 sp. All tropical and subtropical seas. *C. Tranquebaricus*, Gmel. (1, 25). *C. distortus*, Gray (1, 26).

Shell bucciniform, more or less ventricose in the middle, narrowed anteriorly; spire and aperture nearly equal; columella generally with a few transverse ridges; outer lip internally crenated, and with a superior siphonal canal. Operculum ovate, nucleus apical.

Swainson described a group Tritonidea, which Messrs. H. and A. Adams make a subgenus under Cantharus, distinguishing it from the typical form by "Shell turreted; canal lengthened." The distinction is altogether arbitrary, as the spire in the different species varies considerably from the typical species of Cantharus to much higher, but with no considerable break in the series, whilst the canal can scarcely be called "lengthened" in any of them.

CANTHARULUS, Meek. Shell with canal moderately produced, rather narrow and twisted; inner lip smooth throughout, and rather well developed; columella arcuate and twisted, so as to form an obtuse, undefined prominence below; outer lip slightly sinuous above. *C. Vaughani*, Meek and Hayden (li, 63). Cre-taceous; Upper Missouri River.

METULELLA, Gabb.

Distr.—*M. fusiformis*, Gabb (li, 64). Miocene; San Domingo, W. I.

Shell fusiform, canal more or less produced; inner lip covered with a thickened plate, continuous posteriorly with the outer lip. Interior of both inner and outer lips strongly denticulated or transversely striated. Surface cancellate or costate. More distinctly fusiform than Metula, the columella with a row of denticles.

AGASOMA, Gabb.

Distr.—*A. sinuata*, Gabb (li, 65). Miocene; California.

Subfusiform, spire low, body-whorl long; canal moderately

produced and slightly deflected; aperture elongate, labrum simple; labium incrustated with a thin, smooth plate; suture bordered by an elevated portion of the succeeding whorl as in *Clavella*. It differs from *Clavella* in the very short spire and in the short and slightly curved canal.

SUBFAMILY *BUCCININÆ*.

BUCCINUM, Linnæus.

Etyim.—*Buccina*, a trumpet.

Syn.—*Tritonium*, Fabr. *Halia*, Macgill.

Distr.—22 sp. Arctic and boreal seas; low water to 100 fathoms. *B. undatum*, Linn. (1, 27, 28).

Shell ovate or oblong, covered with a horny epidermis; spire elevated, apex acute; aperture large, oval, emarginate in front; canal wide, very short, or a mere oblique truncation of the base of the aperture; columella smooth; inner lip expanded; outer lip usually thin, smooth internally. Operculum ovate, nucleus small near the outer front edge.

The group of shells to which the generic name *Buccinum* was originally applied, a century ago, by Linnæus, has been found by subsequent investigation to contain many heterogeneous forms, and has consequently been greatly subdivided. The name has been retained for the genus typified by *Buccinum undatum*, by common consent, and, I believe, in accordance with the best rules of nomenclature. It is true that Linnæus' first species—that which is to be selected, as in cases where no type is distinctly specified—is a *Dolium*. But in the case of Linnæus' genera, he must be considered to have indirectly specified the type, as he has expressly stated that, in his view, where it becomes necessary to divide a group, formerly supposed to be one genus, the original name must be retained for the subdivision containing the most common species; in other words, that the most common species must be considered as the type of its genus. And he must therefore have regarded the *B. undatum*, the most common of all his *Buccinums*, as the type of the genus.

The Scandinavian naturalists have generally retained the name *Tritonium* of Müller for this genus, but Linnæus' name has priority by many years. *Tritonium*, as proposed, and as frequently used since, would include both the *Murex* and the *Buccinum* of Linnæus.

The genus *Buccinum* is restricted geographically to the temperate and frigid seas of the northern hemisphere. Geologically, the history of the genus commences in the Pliocene formation. They are found in the European tertiary deposits of that age, even as far south as the shores of the Mediterranean. They become very numerous in the Pleistocene deposits, both of

Europe and North America, but reach their maximum development in the existing seas.

The shells of the genus *Buccinum* are peculiarly liable to variation in form and sculpture, and to obsolescence or erosion of the surface markings. This variability, an ordinary characteristic of Arctic shells, renders the discrimination of species extremely difficult.

B. undatum (1, 27, 28) is common to the shores of the northern part of the United States and Europe. Mr. Gwyn Jeffreys writes about it as follows:

“American specimens of the common sort are smaller than European; and Stimpson endeavors to show that they belong to a distinct species, because of ‘a *facies* difficult to describe.’ If the supposed difference cannot be defined by any words or delineation, and the only substitute offered is the nearly exploded idea of representation of species, it is a pity that naturalists should be so unnecessarily perplexed.

“In Scotland and Shetland this common shell-fish is called ‘Buckie,’ in the Isle of Man (according to Forbes) ‘mutlag,’ in Holland ‘wulk’ (Born), in France ‘bouche-aurore’ (Lamarek), at Brest ‘grosse bigorne,’ and at Rochelle ‘burgau morchon’ (De Montfort), and in La Manche ‘ran’ (De Gerville). The common generic name in English is ‘whelk.’ The animal emits a thin and copious slime. From its size and toughness it makes a good subject for anatomical demonstration—although Cuvier has left very little to be known about that part of its history. It burrows in the sand like *Natica catena*; and its foot is similarly traversed by numerous canals, which admit of its being distended by water; this enters by an orifice at the upper corner of the mouth of the shell, and finds its way, through the abdominal cavity, into the vascular system of the foot. When it burrows, the end of the pallial tube or siphon is either exposed or but slightly covered by the sand, so as to supply the gills with water or air as the case may require. Boudant’s experiments show that it cannot live in fresh water. The formation of two opercula by the same individual appears to be congenital, and not owing to an injury of the opercular lobe, which would cause an aborted or defective growth; for in some of these monstrous specimens the twin opercula are so large that they are doubled or folded inwards, side by side, in order to fit the mouth of the shell. This mollusk is very voracious, and is often caught on the fishermen’s hooks. Orsted tells us, in his interesting treatise, ‘*De regionibus marinis*,’ that great numbers of *B. undatum* and *Fusus antiquus* are collected in the Cattegat for fish-bait, by putting a dead cod into a wicker basket and letting it down on a muddy bottom; it is soon taken up half-filled with whelks. The same method is adopted for their capture on the English and Irish

coasts. The whelk affords an illustration of the *lex talionis*; fishes in their turn devour it with equal greediness. I have seen between thirty and forty shells of *B. undatum* extracted from the stomach of a single cod. After the shell has been cleared out and ejected by the fish, it makes a convenient habitation for the hermit-crab. Other nations have not quite so great a fancy as ours for eating the whelk; perhaps it is an indigenous taste; for when the Romans were in this country, they seem to have acquired it—being one which they could not gratify in Italy. Shells of *B. undatum*, mixed with those of the oyster, have been noticed among the ruins of a Roman station at Richborough. At the enthronization feast of William Warham, Archbishop of Canterbury, on the 9th of March, 1504, there were provided ‘8000 whelks at 5s. per 1000.’ In the shell-fish market at Billingsgate the present species goes by the name of the ‘white’ or ‘common’ whelk, in contradistinction to *Fusus antiquus*, which is there called the ‘red’ or ‘almond’ whelk. My obliging informant, Mr. Baxter, says, ‘Wilks must be sold the same day we receive them at market in the summer, being the day after they are caught; if the supply is greater than the demand, we boil them, and they keep good for several days.’ Evidence was given before a select committee of the House of Commons in the session of 1866, on the ‘Whitstable oyster-fishery extension Bill,’ that the whelk-fishery on a sandy flat in that bay yielded £12,000 a year—part of the produce being disposed of in the London market for food, and the rest sent to the cod-fishing banks for bait. They are seldom eaten in the northern part of our Isles. At Dieppe and Nantes they may occasionally be seen exposed for sale in the fish-markets. The embryology of *B. undatum* has been investigated by Baster and many other writers. Its curious spawn-cells are figured in Ellis’s *Corallines* as ‘*Alcyonium seu Vesicularia marina* of Bauhin;’ they are also called ‘Sea wash-balls,’ because of their being used instead of soap by sailors to wash their hands (xvii, 4). Dr. Johnston compares this vesicular mass to the nest of the bumble-bee. It is composed of numerous cartilaginous pouches, of the shape and size of a large split pea, piled irregularly one upon another, and attached by their edges at the base. Cailliaud counted 544 of these cells in one of the spawn-masses. Each cell contains at first several hundred eggs, which are afterwards so greatly reduced in number that only from fifteen to thirty fry come to maturity. The process by which this reduction takes place has been disputed by Scandinavian and English physiologists, not less as to *Buccinum* than with respect to *Purpura*. Koren and Danielssen state that the eggs are first spherical, that they afterwards separate into distinct portions, and then amalgamate or agglomerate and assume a different shape. Sir John Lubbock,

on the contrary, ascertained that the more advanced embryos swallow the other yolks whole, and in such quantities as to become greatly distended; his paper in the 'Report of the British Association' for 1860 contains a representation of 'a young embryo in the act of swallowing an egg.' Before the fry leaves its cell, it is furnished with two rounded and ciliated lobes in front, a proboscis, eyes, foot, gills, heart, otoliths or ear-stones, and other organs, besides a perfectly formed shell of two whorls and an operculum. The spawning season takes place according to the latitude and climate, between October and May; about two months are required for the development of the fry. The shells vary exceedingly in thickness; some are solid and coarsely ribbed; others are thin, and their sculpture is very delicate. Sometimes the top of the shell is broken off, and the opening is closed by a plug. In young specimens the nucleus of the operculum is more central than in the adult, the lateral extension of growth being inwards or towards the pillar."

The egg-cases of *B. Humphreysianum* are separate and hemispherical, on which account Dr. Jeffreys has proposed to separate that species under the generic name *Mada*, its surface being glabrous.

BUCCINOPSIS, Jeffreys.

Syn.—*Liomesus*, Stimpson.

Distr.—3 sp. Northern Europe, Siberia, Alaska. *B. Dalei*, Sowb. (1, 29).

Shell bucciniform, smooth or spirally striulate, last whorl inflated; aperture obliquely truncate below. Operculum small, subtriangular, nucleus apical.

Dr. Jeffreys, who places his genus in the family Muricidæ, remarks that "the principal difference between this genus and *Buccinum* consists in the operculum, the nucleus of which is in *Buccinopsis* terminal, at the inner base of the mouth, the increase taking place by semielliptical layers; while in the other genus it is placed within the edge, at the outer side of the mouth, the increase taking place by concentric layers. The egg-cases of *Buccinopsis* are separate, and shaped like a well-filled leather purse, the opening for the egress of the fry being at the top and very wide."

NEOBUCCINUM, E. A. Smith.

Distr.—The preceding genera, *Buccinum* and *Buccinopsis*, are inhabitants of the Arctic sea; this, of the Antarctic waters. *N. Eatonii*, E. A. Smith (1, 30, 31).

Shell bucciniform, smooth, thin; aperture obliquely, widely notched below. Operculum subspiral. Dentition resembling that of *Neptunea*.

Mr. Smith founds his genus principally upon the paucispiral

operculum, but the figure given by him shows an operculum which is no more curved than occurs sometimes in the genus *Sipho*, for example. This, with the dentition, indicates relationship with *Neptunea*, but the absence of a canal in the shell, on the other hand, relates it to *Buccinum*.

VOLUTHARPA, Fischer.

Distr.—7 sp. Japan, Siberia, Sitka. *V. Perryi*, Jay (1, 32).

Shell ventricose, thin; spire short, body-whorl and aperture very large. Operculum usually wanting; when present, at first with apical nucleus, afterwards becoming annular.

This little group of mollusks is confined in distribution to the North Pacific Ocean, its metropolis being Japan. Three of the species were originally described as *Bullia*, from which genus it differs in its simple foot and in possessing eyes as well as in dentition. The form and porcellaneous texture of the shell are like *Bullia*, and serve to separate it from *Buccinum*. Mr. Arthur Adams says that the animal is like *Buccinum*, of a white color sparsely sprinkled with black on the head, foot and siphon; the tentacles are broad, close together at the base, and rather short, with the eyes on the outer side, near the middle; the siphon is thick and short, and the foot is fleshy and simple behind.

“The ova-capsules of *Volutharpa* are not at all like those of *Buccinum*, but rather like those of *Fulgur*, though smaller, consisting of disk-like capsules, united by one edge to a ribbon or stalk. They contain from eight to twelve embryos, which attain the length of one-half inch, and a shell of two whorls, which, except in the absence of epidermis, essentially resembles the adult. The first whorl, however, is whitish and amorphous, and very fragile; it is large for the size of the embryo, and is invariably lost in shells which have attained maturity. The remainder of the embryonic shell is translucent purplish red, or wine-color, with revolving lines. I found the embryos on the point of escaping from the ova-capsules in September. The disks of the capsules are three-quarters of an inch in diameter and two-tenths of an inch thick, with the edges perpendicular to the top and bottom, and the angles serrate or furnished with slight coriaceous projecting points.”—DALL.

CHLANIDOTA, Martens.

Distr.—*C. vestita*, Martens (1, 33). Kerguelen's Island.

Shell subglobose, thin, spirally costate. Operculum with apical nucleus. Dentition: middle plate with five teeth, the outer ones much smaller, laterals with three teeth, the middle one smallest, the outer one somewhat smaller than the inner.

COMINELLA, Gray.

Distr.—20 sp. Cape, N. Zealand, Australia. *C. limbosa*, Lam., var. (1, 34).

Shell bucciniform, marked or spotted, covered with an epidermis; spire short, acute, last whorl large, ventricose, with a posterior depressed groove at the suture, producing a contraction at the hind-part of the outer lip. Operculum with apical nucleus.

H. and A. Adams (*Genera*, ii, 615) make *Adamsia*, Dunker, a subgenus of *Cominella*; the operculum and facies of the type show it, however, to = *Urosalpinx*.

JOSEPHA, Tenison-Woods. Founded upon the *C. Tasmanica*, which differs from *Cominella* in possessing a plait upon the columella.

CLEA, A. Adams.

Distr.—11 sp. Fresh water. Borneo, Java, Siam, Cambodia. *C. nigricans*, A. Ad. (1, 35).

Shell turbinate, covered by an epidermis, aperture ovately acute, truncate at base and profoundly sinuate, dextral margin regularly arcuate, parietal callus none or thin. Operculum sub-trigonal, with apical nucleus.

First proposed as a genus of the family Melanidæ, which the shell resembles in its form, epidermis and habitat in fresh waters, especially reminding one of the genus *Hemisinus*. The operculum with its apical nucleus, no less than the lingual dentition, whereof the formula is 1.1.1 in *Clea*, instead of 3.1.3 as in *Melania*, induced Brot to remove the species to Buccinidæ; and the form and sculpture of the shell do not contravene such a disposition of *Clea*, its fluviatile distribution being really the strongest argument for considering it a *Melania*.

CANIDEA, H. Adams. Shell small, fusiform or turbinate, covered with an epidermis; spire longer than the aperture, apex eroded; whorls slightly convex, plicate; aperture elongately ovate, emarginated in front; columella truncate; lip simple, sinuated in front. Operculum small, unguiculate; nucleus apical. Living in fresh water. *C. Helena*, Meder (1, 36). *C. Cambodiensis*, Rve. (1, 37).

ERIPACHYA, Gabb.

Distr.—*E. perforata*, Gabb (li, 66). Cretaceous; California.

Shell short, robust, subovate to subfusiform, spire moderately elevated. Aperture broad, terminating in advance in a very short canal or a mere notch; outer lip simple; inner lip more or less heavily incrustated. Surface marked by longitudinal ribs and revolving lines.

PSEUDBUCCINUM, Meek and Hayden.

Distr.—*P. Nebrascense*, M. and H. (li, 67). Cretaceous; Moreau R.

Shell oval, thin, ventricose; spire very short; body-volution large, not produced below; aperture large, terminating below in a rounded sinus; outer lip thin and simple; inner lip very thin, smooth, and closely and very broadly folded upon the imperforate umbilical region and body-volution above, so as to form, with a low revolving umbilical ridge, a kind of profoundly arcuate, strongly spiral, false columella; surface with more or less distinct revolving lines and furrows.

Meek is inclined to believe that *Bullia ampullacea* is a living example of his genus; if so, *Volutharpa*, Fischer, will have priority over *Pseudobuccinum*.

ODONTOBASIS, Meek.

Distr.—*O. ventricosa*, Meek (li, 68). Cretaceous; Dakotah.

Shell buccinoid-fusiform; spire more or less produced; body-volution ventricose, and separated below from the short narrow beak, by a sharply-defined, narrow, revolving sulcus, that terminates below at the connection of the outer lip with the canal, in a small tooth-like projection; outer lip thin, smooth within, and nearly straight in outline; inner lip not thickened, but well-defined; columella a little twisted, slightly flattened, and bearing two oblique plaits below, the lower one of which is formed by the raised lower edge of the obliquely truncated columella, and the other, which is very obscure, or perhaps sometimes obsolete, placed a little above the same; surface ornamented by vertical folds and revolving lines and furrows.

This genus, referred doubtfully to the Buccinidæ by Meek, seems to unite characters of several different groups; the shell is Buccinoid in form and sculpture, but the fold and tooth remind one of Fasciolaridæ, whilst the truncate columella recalls the Nassæ.

ECTRACHELIZA, Gabb.

Distr.—*E. truncata*, Gabb (li, 69). Miocene; San Domingo, W. I.

Shell acuminate oblong, spire elevated (always truncated in the only species known). Surface compressed near the suture. Inner lip incrustated; columella sinuous, short; outer lip produced in advance.

This genus seems to be allied in many of its characters to *Cominella* and *Truncaria*. Like them, it is compressed adjoining the suture. It shows no trace of umbilicus, as seen in most of the Buccinidæ, but its most distinctive character is in its obliquely subtruncated columella, which does not reach to the anterior end of the shell.

BRACHYSPHINGUS, Gabb.

Distr.—*B. liratus*, Gabb (li, 70). Cretaceous; California.

Shell bucciniform, short, robust, thick; spire low; aperture large, notched anteriorly; outer lip simple; inner lip incrustated with a smooth callus; surface longitudinally ribbed or striate. Allied probably to *Cominella* or *Volutharpa*.

LACINIA, Conrad.

Distr.—*L. alveata*, Conr. = *Pyrula Smithii*, Lea (li, 71). Eocene; Ala.

Globose; pillar lip widely reflected, with a heavy posterior callus; basal emargination profound; base dilated; aperture with a posterior channel; outer lip simple.

This does not differ very much from the recent *Cominella maculata*, Martyn.

HAYDENIA, Gabb.

Dedicated to Dr. F. V. Hayden, U. S. Geologist.

Distr.—*H. impressa*, Gabb (li, 72). Cretaceous; California.

Shell massive, allied, in general form, to *Oliva*, spire low. Outer lip simple, not thickened nor crenulate; inner lip incrustated, callus marked posteriorly, without teeth or folds; canal slightly recurved; anterior extremity of the mouth notched, and a small sinus at the posterior extremity of the aperture, where the outer lip unites with the body-whorl. Surface ornamented as in some of the Buccinidæ. This curious form is probably a link between *Buccinum* and *Volutharpa*.

SUBFAMILY EBURNINÆ.

EBURNA, Lam.

Etym.—*Ebur*, ivory.

Syn.—*Latrunculus*, Gray. Babylonia, Schlüt.

Distr.—14 sp. Red Sea, India, Cape, Japan, China, Australia. *E. spirata*, Lam. (l, 38, 39).

Shell ovate-oblong, thick, porcellaneous, under a thin epidermis; deeply umbilicated; spire acuminate, whorls more or less convex, suture more or less channelled; aperture oval; columella arcuated, posteriorly callous; inner lip spreading, often covering the umbilicus in the adult; outer lip simple, acute. Operculum with apical nucleus.

The Eburnæ comprise a small, very well defined group of about a dozen species, the generic character being unmistakable in all of them. The whorls have more or less shoulder; those of *E. Zeylandica*, showing the least, being a mere slight flattening of the contour next below the sutures, whilst in *E. spirata* there is a regular channel out of which arises the preceding whorl. The species are all largely umbilicate, but in some of them the umbilicus is covered or filled, more or less completely, by the callous inner lip; the umbilical region is defined by a strong rib. A thin,

dark brown epidermis, sometimes translucent, covers the living shell, but cabinet specimens are usually denuded of this, exhibiting upon an ivory-white surface, spots and maculations of orange-red. The aperture is usually white, sometimes tinged with violet upon the columella. This pattern of coloring is most uniform throughout the genus; but the species are distinguished by modifications of the arrangement of the color-spots, as well as by the differences of shoulder and umbilicus. None of the species are strictly banded, although in some the coloring coalesces into irregular revolving masses. The coloring reminds one strongly of Phasianella, whilst the shell, except for the want of its characteristic groove and tooth, recalls the genus Pseudoliva—one of the species of which was formerly erroneously referred to this group. The surface of the shell is invariably smooth, devoid of the sculpture of ribs, striæ, tuberculations, etc. The operculum is ample, filling the aperture. The Eburnæ are natives of the tropical seas of the Eastern hemisphere.

ZEMIRA, H. and A. Adams. Umbilicus moderate; outer lip with a tooth near the fore-part. The revolving channel near the base of the shell, ending in a tooth-like projection on the outer lip, has induced Sowerby to class this species in the genus Pseudoliva; it seems nearly related to Eburna, however. *E. Australis*, Sowb. (1, 40).

MACRON, H. and A. Adams.

Distr.—4 sp. California, W. Patagonia. *M. Kellettii*, A. Ad. (1, 41).

Shell ovate, solid, with a thick epidermis; spire elevated; columella wrinkled, with a callosity at the upper part; outer lip thin, with a small tooth anteriorly. Operculum ovate, with apical nucleus.

This was originally described as a subgenus of Pseudoliva, which it resembles in having an inferior revolving groove terminating in a small tooth-like projection of the outer lip; the operculum, however, is unguiculate like that of the Eburnæ, whilst that of Pseudoliva is purpuroid. The more decided canal and absence of sutural channel, and the rather persistent blackish brown epidermis, will distinguish it from the subgenus Zemira of Eburna. Its locality, West Coast of America, is also a distinctive character; Eburna being East Indian, and Pseudoliva African in distribution.

SUBFAMILY PHOTINÆ.

PHOS, Montfort.

Etym.—Phos, light.

Syn.—Rhinodomus, Swm. Strongylocera, Mörch.

Distr.—20 sp. All tropical and subtropical seas. *P. senticosus*, Linn. (1, 42, 43).

Shell cancellated, oblong, acuminated, usually longitudinally ribbed; outer lip striated internally, with a slight sinus near the fore-part; columella obliquely grooved, or with a single plait in front. Operculum claw-shaped, nucleus apical.

The animal of *Phos* has a small head, with the tentacles approximating or connate at their base, and eyes near their tips; foot dilated, forming an auriculate, shield-like lobe in front, and terminating behind in a long, tapering filament.

The species of *Phos* bear some resemblance to *Nassa*, and were originally placed in the family Nassidæ; from which, however, they are distinguished by certain good conchological and malacological characters. The turreted form, cancellated surface and grooved interior of aperture are common to *Nassa* also, but the oblique basal fold of the columella is characteristic of this genus. The animal differs from *Buccinum* in the foot, ending in a filament behind: *Nassa* has a bifid posterior termination.

NASSARIA (Link), H. and A. Adams.

Syn.—Hindsia, Ads.

Distr.—10 sp. Indian O., China, Japan, Philippines. *N. acuminata*, Rve. (1, 44).

Shell ovately fusiform; spire acuminated, whorls longitudinally ribbed and cancellated; aperture ending anteriorly in a long recurved canal; inner lip thin, circumscribed, transversely corrugately plicated; outer lip grooved internally. Operculum ovate, nucleus apical.

Animal with the tentacles connate at the base, with the eyes near their distal ends; foot anteriorly produced, ending behind in a simple tail without filament.

This genus partakes of the characters of several recognized forms. Its animal, however, differs from that of *Triton* in the approximated tentacles, with the eyes near their ends, and the anteriorly produced foot; from that of *Nassa* in the tail not being bifurcated. In its shell it may be known from *Phos* by its recurved canal; from *Nassa* by its circumscribed inner lip and elongated canal; and from *Triton* by its want of irregular varices.

CYLLENE, Gray.

Distr.—10 sp. Indian O., China, Philippines, W. Africa. *C. lyrata*, Lam. (1, 45, 46).

Shell ovate; spire short, acute, suture canaliculated; columella concave, smooth or finely grooved; outer lip with a slight sinus at the fore-part, emarginate posteriorly, grooved internally. Operculum with terminal nucleus. Dentition unknown.

The species of *Cyllene* inhabit the intertropical coasts of Africa,

the Malaysian Archipelago, etc. They live with the Nassas along shore-lines and do not appear to inhabit great depths. The animal, which is unknown, is supposed, from the sutural slit which characterizes the shell, to possess a mantle provided with a prolongation or fold occupying the slit, somewhat analogous, perhaps, with that of *Oliva*. The operculum of *C. lyrata* is elongated, rhomboidal, with terminal nucleus, externally concave, internally convex.

CYLLENINA, Bellardi, 1882. Spire more produced, the last whorl about half the length of the shell; parietal wall of the aperture concave, without lip; columella terminating anteriorly in an oblique truncation, which is usually ridged. 12 sp. Tertiary; Northern Italy. *C. Ancillariæformis*, Grat. Appears to connect Cyllene with Nassa.

BUCCITRITON, Conrad.

Syn.—*Sagenella*, Conrad.

Distr.—*B. cancellatum*, Lea = *sagenum*, Conr. (li, 73). Eocene; Alabama.

Genus not characterized. One of the typical specimens of *B. sagenum* has a single varix on the back of the body-whorl, but the other specimens are without it, so that its non-absorption may be regarded as accidental. *B. altum* is a different type of shell entirely, and looks something like a *Truncaria*.

FAMILY NASSIDÆ.

Shell ovate, spire usually elongated, base of aperture a notch or short recurved canal, inner lip usually callous. Operculum corneous, ovate, nucleus apical, margins plain or serrated. Animal having two small processes or tails at its posterior extremity. Lingual teeth arched, pectinated; the uncini with a basal horn, and occasionally intermediate serrations. Dentition (x, 13).

Many fossil species are known, commencing with the Eocene.

NORTHIA, Gray.

Distr.—3 sp. Panama, Philippines. *N. serrata*, Dufresne (lii, 74).

Shell elongated, turreted, polished; spire elevated, acuminate, whorls depressed and sloping at their upper part; aperture shorter than the spire; outer lip with the margin serrated. Dentition unknown.

This genus is in its general aspect much closer to *Pusionella* in the family Terebridae than to the genera with which it is here (and has been heretofore) associated; the variceal thickening at or near the outer lip is, however, a feature which does not

obtain in the Terebridæ. *Pusionella*, moreover, has a concentric operculum, with its nucleus near the middle of the inner margin. Perhaps the figured operculum of *Northia* is abnormal; it has that appearance. I think that if these shells had not been assigned to the Nassidæ or to any other family, I would have placed them in Terebridæ; as it is, I prefer to allow them to remain here, rather than possibly complicate the subject by changing their position.

TRUNCARIA, Ads. and Beeve.

Distr.—6 sp. Philippines, Panama, L. California. *T. modesta* Powis (lii, 75).

Shell acuminate oblong, thick; suture of the spire channeled; aperture anteriorly dilated, posteriorly subemarginated; columella arcuated, abruptly truncated in front, with a single anterior fold. Dentition unknown.

BULLIA, Gray.

Distr.—25 sp. S. Africa, Indian Ocean, E. and W. Coast of S. America, Tahiti. *B. callosa*, Gray (lii, 79).

Animal without eyes; tentacles long and slender. Foot enormously expanded, and bifid behind in the typical species. Operculum pointed, nucleus apical.

Shell ovate or turreted; spire more or less acuminate, sutures enameled; inner lip excavated in the middle, callous posteriorly; aperture oval, moderate.

Bullia (restricted) has a raised band of enamel round the sutures of the whorls, as in *Ancillaria*. The animal has the faculty, according to M. Quoy, of absorbing, through the pores of its foot, a great quantity of water, which it ejects, when disturbed, in various directions; it is caught by baiting lines with bits of flesh. The genus is Oriental, mostly S. African in distribution, and reminds one of the Arctic genus *Volutharpa*.

In Woodward's "Manual of the Mollusca," *Bullia* is erroneously made a synonym of *Anaulax*, Roissy, a fossil form of *Ancillaria*.

BUCCINANOPS, d'Orb. Shell with the whorls somewhat angulated, and with a rounded or nodulous band next the sutures. Embraces three species from the southern parts of the Coast of South America. They are of rude growth, usually with a flattened shoulder below the sutures. *B. annulata*, Lam. (lii, 77).

PSEUDOSTROMBUS, Klein. (*Leiodomus*, Swains.) Shell elongated, smooth, without epidermis, last whorl ventricose; spire acuminate; aperture ovate, columella arched, smooth or transversely striated, outer lip thin. No enamel round the sutures. *B. polita*, Linn. (lii, 78).

ADINUS, H. and A. Adams. Shell subulate, spirally striated; columella abruptly truncated at base; inner lip corrugated, with

a callosity at hind-part; outer lip grooved internally, externally marginated. *B. truncata*, Rve. (lii, 76).

MOLOPOPHORUS, Gabb. Short, robust, spire moderately elevated, suture bordered by a more or less distinct carina. Surface longitudinally ribbed or striate. Aperture obtuse behind, and very slightly notched; outer lip simple, inner lip very slightly incrustated, sinuous, anterior notch small, but distinctly defined. *B. striata*, Gabb (lii, 80). Cretaceous; California.

[BULLIOPSIS, Conr. Placed by its author at first as a subgenus of Nassa, it was subsequently removed by him to Melanopsidæ. It has some resemblance to Bullia.]

NASSA, Lam.

Distr.—131 sp., of world-wide distribution. Fossil, numerous species. Eocene.—*N. mutabilis*, Linn. (lii, 81).

Shell ovate, ventricose, body-whorl variously sculptured; aperture ovate, with a short, reflected, truncated, anterior canal; inner lip smooth, often widely spread over with enamel, with a posterior callosity or blunt dentiform plait; outer lip dentated, internally crenulated. Margin of operculum serrated or entire.

The animal of Nassa has a broad head, and a foot quadrately expanded in front, with the corners often pointed, whilst behind it bifurcates and is prolonged frequently into two subulate tails. The operculum is usually serrate on the margin, but is sometimes plain. The Nassæ are very active, and not at all shy when kept in confinement. They may be occasionally seen floating with the foot upwards. They are predaceous, feeding on other mollusks, the shells of which they bore. I have frequently seen the shells of the American species themselves bored, the hole being of such a size as to suggest cannibalism. Perhaps the avenger of their misdeeds is a beautiful and very active hermit crab which disports itself in the Nassa's shell, immense multitudes being seen at low tide in the water near the shore-line. Whether begged, borrowed, stolen, or lawfully captured by the red right claw, it is certain that, at Atlantic City, New Jersey, the hermit inhabits a vast majority of the specimens of Nassa occurring to the collector. Although most of the species are littoral, a few have been collected at considerable depths; *N. brychia*, Watson, was dredged at 620 fathoms by the "Challenger Expedition." Some of them have been observed to spring up and throw themselves over on being suddenly disturbed. Usually they glide along the surface of the mud, leaving a track indicating their line of march, at the end of which is a small round pellet; under this the creature conceals itself. The fry twist and twirl about by means of their ciliated lobes. *N. mutabilis* is an article of food in Italy. The generic name is that of a narrow-necked wicker basket used for catching fish, and in such a basket, lob-

ster pots, etc., the *Nassa* itself is frequently caught, attracted thither by odors savory.

Nassa reticulata is said to be very destructive in the oyster-parcs of Arcachon (France). It is so numerous that a single tide has yielded 14,600 specimens within a space of 40 French hectares (= about 100 acres). The adult *Nassa* will bore through the shell of an oyster three years old within eight hours; but the young shells are far more destructive, because they select the tender shells of the very young oysters, sometimes piercing fifteen or twenty in succession before their hunger is satisfied. An oyster a month old is destroyed in a half-hour.

According to M. Lespés, *N. reticulata* is preyed upon by a parasitic Trematode (*Cercaria sagitata*) which infests its liver. Its spawn-cases are deposited on the leaves of *Zostera* and on various other things which are left dry only at spring-tides; the capsules are arranged in rows, and so closely that they overlies each other "like the brass scales of the cheek-band of a hussar" (Johnston). They are compressed pouches, each of the size of a large spangle, supported on a very short stalk, with a small opening at the top to allow the fry to escape. Mr. Peach has given us some amusing particulars of the fry. These behaved themselves like the fry of other gastropods, skipping about and whirling round by means of their ciliated lobes, apparently in a state of pleasurable excitement; but it seems that the exercise was compulsory or necessary to prevent the attacks of a swarm of infusoria, which made short work of any tired or feeble infant *Nassa*.

The following "subgenera" may be retained as convenient group designations, although the species, varying much in their sculpture, cannot always be positively assigned:

ARCULARIA, Link. (Eione, Risso.) Body-whorl gibbous on the back; spire produced; callus of inner lip greatly extended and covering the spire. *N. Thersites*, Brug. (lii, 82, 83).

NAYTIA, H. and A. Adams. Shell smooth; aperture with a channel at the hind-part continued up the spire. *N. glabrata*, Sowb. (lii, 84).

ALECTRION, Montf. (Monoceros, Fleming.) Spire elevated, whorls glabrous, polished or papillary; inner lip spreading; outer lip denticulate, not variced externally. *N. glans*, Linn. (lii, 85).

ZEUXIS, H. and A. Adams. (Telasco, H. and A. Adams. Nassodonta, H. Adams. Zaphon, H. and A. Adams.) Spire elevated, smooth, or longitudinally plicate, polished; inner lip with the callus defined, or somewhat spreading; outer lip externally variced, sometimes dentate anteriorly. *N. canaliculata*, Lam. (lii, 86, 87).

ACICULINA, H. and A. Adams. Shell turreted, polished, smooth,

or longitudinally plicate; inner lip with the callus sharp, straight, defined; outer lip produced in the middle, variced externally. *N. maculata*, A. Adams (lii, 88).

PHRONTIS, H. and A. Adams. Spire elevated, acuminate, whorls ribbed or nodulous, distinctly shouldered; inner lip smooth, with an extended, thickened callus, outer lip with an external varix. *N. luteostoma*, Brod. and Sby. (lii, 89).

HEBRA, H. and A. Adams. Whorls spinose, muricated or sharply tubercular; inner lip with the callus defined; outer lip with a marginal varix, when adult. *N. muricata*, Quoy (lii, 90).

HIMA, Leach. (Tritonella, A. Ad.) Spire elevated, whorls cancellated; inner lip with a rugose callus, callus defined; outer lip with a marginal varix. *N. Tritoniiformis*, Kiener (lii, 91).

NIOTHA, H. and A. Adams. Shell cassidiform; spire short, whorls granulated or cancellated; inner lip with the callus very large and spreading; outer lip crenate, not variced externally. *N. Kieneri*, Desh. (lii, 92).

TRITIA, Risso. (Uzita, H. and A. Adams.) Spire elevated, whorls reticulated; inner lip smooth, with the callus moderate; outer lip simple, not variced. *N. trivittata*, Say (lii, 93).

ILYANASSA, Stimpson. (Cæsia, H. and A. Adams. Schizopyga, Conrad.) Shell dark olive-brown, reticulated, outer lip without varix, striate within, columella covered with a spreading callus. Operculum with entire (not serrated) margin. Animal having a broad foot, not bifurcated behind as in *Nassa*. *N. obsoleta*, Say (lii, 94).

The characters proposed by Stimpson include an operculum without serrated margin, and the animal without posterior bifurcation. Although the operculum is usually serrated in *Nassa*, Mr. Marrat has enumerated a dozen species in which it has been observed to have plain margins, or nearly so; and Dr. von Martens states that the European *N. reticulata* is found in the mud-flats of the Venetian lagunes with the operculum plain on one side and somewhat serrated on the other, and that the end of the foot is but slightly notched in these specimens instead of being deeply bifurcated. Under these circumstances, it becomes very doubtful whether the group *Ilyanassa* ought to stand. I have concluded to retain it provisionally, especially as it may include several species conveniently separable from *Tritia* by having dark-colored shells.

The animal of the common American species, *N. obsoleta*, Say, is variously mottled with slate-color, the tentacula are suddenly diminished above the eyes, and become bristle-like. Its movements are very active, and it collects in numbers about dead crabs and other marine animals, on which it feeds. Inhabits all our muddy shores, preferring situations not exposed to the surf of the open sea; such as inlets and extended flats which are

drained at low tide. It is found abundantly at the confluence of fresh and salt water, where the taste is merely brackish. No shell of equal size is so abundant on the whole Atlantic shore. The younger shells are most likely to be collected, because the old ones become very much eroded and defaced, and a greenish mould-like plant vegetates abundantly upon them. Very few, therefore, of the shells usually collected, have the lines on the interior of the outer lip. The ova-capsules are laid during April and May, are of transparent corneous texture, singly attached to the inside surface of a valve of *Mactra*, or the inner face of the nidus of *Natica*; they are deposited in vast numbers, completely covering the object to which they are attached and crowded together promiscuously.

VENASSA, von Martens. Base with a callous spiral deposit encircling the indented umbilicus. *N. pulvinaris*, von Mart. Timor.

PTYCHOSALPINX, Gill. Shell ovate, buccinoid, whorls regularly rounded and ventricose; spire moderate (about as long as the aperture), furnished with equal revolving linear ridges, siphonal canal very short, very obliquely twisted and concurrent with the siphonal fasciole; aperture rhombo-ovate, oblong; labrum entire, not sinuous, smooth within; columella inversely sigmoidal, concave near the middle, with a very thin callous deposit and with a revolving linear plait in front. Dr. Gill refers this group to the family Buccinidæ, but I agree with the late Mr. Conrad that his description indicates (as do the types cited) Nassæ. *N. scalaspira*, Conrad (lii, 95). Miocene; Virginia.

PARANASSA, Conrad. Differs from *Ptychosalpinx* in the submargin of the labrum being slightly thickened within and striate; siphonal canal shorter. Eocene, Miocene; America and Europe. *N. granifera*, Conr. (lii, 96). Virginia. As one of the two specimens of the type of *Paranassa* is striate within the aperture, while the other is smooth, probably the distinction from *Ptychosalpinx* will not hold good.

TRITARIA, Conrad. Elongated, subturrited, labrum not thickened within. This does not seem to differ generically from the true Nassas; it has very little resemblance to *Ptychosalpinx*. *N. peralta*, Conrad (lii, 97). Miocene; Virginia.

NERITULA, Plancus.

Syn.—Cyclops, Montf. Cyclonassa, Swains. Nana, Schum. Cyclocyrtea, Agass.

Distr.—3 sp. Mediterranean, Black Sea. *N. neritea*, Linn. (lii, 98, 99).

Shell ovate, depressed, axis distorted; spire flattened, oblique, whorls smooth; aperture depressed; columella smooth; inner lip

callous, spread over the body-whorl, outer lip reflected, not denticulate or striated.

In *Neritula* the last whorl is depressed and extends over the penultimate whorl, nearly covering and concealing the spire, which consequently appears very obtuse. The animal has a bifid tail, and operculum similar to *Nassa*. H. and A. Adams' genus *Teinostoma* was originally placed next to *Neritula*, in their "Genera;" subsequently they removed it to the *Rotellidæ*.

DESMOULEA, Gray.

Distr.—6 sp. Senegal, Cape of Good Hope, Japan. *D. abbreviata*, Wood (lii, 100).

Shell ovate-globose, covered with a downy epidermis; spire short, conical, apex papillary; whorls depressed; aperture ovate; inner lip thickened, with a ridge posteriorly; outer lip contracted, thickened externally, plicated internally. Dentition unknown.

Desmoulea is remarkable for its obtuse apex and solid growth, much resembling some species of *Cassididæ*; when in fine condition, the shell is clothed with a velvety epidermis, but most cabinet specimens are denuded of this. The animal is unfortunately unknown, and therefore the systematic position of the genus remains somewhat uncertain—for, whilst some species connect closely with *Nassa*, the revolving sculpture, globose form, sunken suture and mouth of others are suggestive of *Semicassis*.

FAMILY TURBINELLIDÆ.

This group includes a few ponderous tropical species, allied in the characters of the mouth, and in general form and ornamentation, to the *Peristerniinae* on the one hand, whilst in size they approach the *Volutidæ*. The plications on the middle of the pillar are rather distant, narrow, high, and transverse, whilst in *Fascioliariinae* they are situated lower, are not so prominent, and oblique in direction. The epidermis is frequently persistent.

The animal (of *Vasum*) is slow-moving, timid and inactive, shrinking quickly within the shell on the slightest alarm. The operculum is ovate, acute, with an apical nucleus; it is very thick, claw-like, and partially free at the hind-part. The dentition (x, 14) resembles somewhat that of the *Buccinidæ*, differing in the lateral teeth; it differs widely from the *Nassidæ*, and quite as much from that of the *Fascioliariinae* or *Peristerniinae*.

TURBINELLA, Lam.

Etym.—Diminutive of *turbo*, a top.

Syn.—*Mazza*, Klein. —*Rapum*, Swains.

Distr.—4 sp. Indian Ocean, Coast of Brazil. *T. pyrum*, Linn. (lii, 1).

Thick, obconic, smooth, last whorl large; spire obtuse, apex papillary; aperture oblong, narrow; canal long and straight; columella with several strong, transverse plaits in the middle; outer lip thin, simple. Animal unknown.

The shank or chank (*Turbinella pyrum*) is the sacred shell of the Hindoos, and the national emblem of the Kingdom of Travancore. The god Vishnu is represented as carrying a chank shell in one hand and a chakra in the other.

The principal demand for these shells is for making bangles or armlets and anklets, and the manufacture is still almost confined to Dacca. The shell is cut or sliced into segments of circles, or narrow rings of various sizes, by a rude semicircular saw, the hands and toes being both actively employed in the operation. Some of these bangles, worn by the Hindoo women, are beautifully painted, gilded and ornamented with gems.

The shell rings are coated inside with plaster to smooth the roughness. Filagree-bordered edges of plaster are also added, patterns and devices of red, blue and gold are figured on them, and they are further ornamented with silver or gold tinsel, spangles, small colored glass beads, etc. The larger bracelets, formed of many segments, are made to open to admit the hand, by two spiral pins, which unscrew and let out the piece. These bangles are not removed at death, and hence there is a continual demand for them, many wearing several, both on the legs and arms.

The mammillary apex of the shell is made into a button or bead; the latter are called krantahs, and necklaces of these are so commonly worn by the Sepoys in the British East India service as almost to be deemed a regular part of their uniform.

CARICELLA, Conrad. Columella-folds decreasing in size from above, as in Mitra, base canaliculate and not emarginate. The small group of fossils referred to it may be said to resemble Turbinella in essential characters, the difference being that the folds are situated lower down on the pillar, and that the shell is thinner. *T. prætenuis*, Conrad (lii, 2). Eocene; Claiborne, Alabama.

VASUM, Bolten.

Syn.—Cynodonta, Schum. Scolymus, Swains.

Distr.—7 sp. Zanzibar, Brazil, West Indies, Panama, Philippines, Indian Ocean, Mauritius, Polynesia. *V. cornigerum*, Lam. (lii, 3).

Shell oval, oblong, solid, tubercular or spinose, with spinose fascioles below; spire short, apex not papillary; aperture oblong; canal short, somewhat recurved; columella with several transverse folds in the middle; outer lip thickened and sinuous.

FAMILY VOLUTIDÆ.

Shell turreted, aperture notched in front, columella obliquely plaited; no operculum in the larger species. Animal with recurved siphon, foot very large, partly hiding the shell, eyes on the tentacles or near their bases. Dentition (x, 7).

CYMBIUM, Klein.

Boat-shell. *Syn.*—Yetus, Gray.

Distr.—5 sp. W. Mediterranean, W. Coast of Africa. *C. proboscoidale*, Lam. (liii, 4; i, 15).

Shell oval-oblong, ventricose, thin; spire short, nucleus large, globular, forming an obtuse papillary apex; whorls few, forming a flat edge around the nucleus; aperture oblong, wide; columella with several oblique plaits; outer lip thin, simple.

The animal is large, compared to the size of the shell, when expanded. The foot partially covers the shell, which is sunk into its substance. There is no operculum. Ovoviviparous, the young when born being of a large size and covered with a shell with a large irregular callous apex. They leave the parent when they have attained a length of about an inch, the brood appearing to consist of four or five individuals. Adanson observes that the high winds of April cast the "yet" up in such vast quantities as sometimes to cover the shore, the natives of Senegal using them as food.

Cymbium is separated from Melo by its flat or slightly channeled shoulder and want of coronal spines. When fresh, the epidermis is more or less covered by a thin glaze deposited by the enveloping mantle.

MELO, Humphrey.

Distr.—10 sp. Indian Ocean, Australia, etc. *M. tessellata*, Lam. (liii, 5).

Shell large, subovate, ventricose, thin; spire short, apex obtuse, papillary, persistent; whorls smooth, the last posteriorly coronated; aperture oblong, wide; columella with several oblique plaits, the anterior the largest; outer lip simple, acute, obliquely truncate in front. No operculum.

The apex of the shell is spiral, regular, very different from the shapeless apex of Cymbium. This genus, like Cymbium, is ovoviviparous, the young ones being arranged in the oviduct of the female in a long string, without egg-shells.

VOLUTA, Linn.

Syn.—Volutolyria, Crosse. Scaphella, Swains. Scapha, Gray.

Distr.—About 75 sp. Indian Ocean, Japan, Alaska, Australia, Eastern Polynesia, Atlantic Coasts of Southern South America, to West Indies, Southern Africa, etc. No species exist in the

seas of Europe, although they were numerous during the tertiary epoch; *V. abyssicola*, an African species, is the sole surviving representative of the group to which most of these small tertiary species belonged. Australia is the metropolis of the Volutes, and, as M. Crosse remarks, a triangle the respective points of which shall include Ceylon, Japan and New Zealand will cover the habitat of about 80 per cent. of the species. Fossil, 250 sp. Cretaceous; Europe, Asia, N. America. *V. musica*, Linn. (liii, 6).

Shell ovate or subconical, thick, solid; spire usually short; shoulder of whorls usually angulated, sometimes nodose or spinous; aperture generally rather narrow; columella with a callous deposit and plaited; lip generally thickened, sometimes subreflected.

Animal having eyes on lobes at the base of the tentacles; siphon with a lobe on each side at its base. Usually no operculum (there is an operculum in *V. musica*, Linn.).

This genus is oviparous, at least the South American species are so, and M. Duhant-Cilly has given us some interesting particulars concerning them. He noticed the Volutes in clear shallow water in Magellan's Straits, and, with the aid of natives, procured specimens—which nearly all grasped dead shells of *Venus exalbida*, a common bivalve of that locality. Upon examining these shells they were found to contain within the cavity of one of the valves, a round, slightly convex membrane, comparable for size and transparency with a watch-glass. The contents appeared to be merely a milky fluid in some cases, but in others, the egg having advanced further in development, three or four small, but perfectly formed Volutes could be seen swimming in the fluid, which had become transparent. D'Orbigny also collected large numbers of these eggs, and in the month of February saw the young Volutes, four or five in number, in each. The containing membrane, which becomes corneous, he describes as 80 to 100 millimetres in length, more than half the size of the animal which lays it, and he conjectures that it expands after coming into contact with the water.

VOLUTA (typical), Gray. Longitudinally plicate, plicæ becoming prominent on the shoulder, columella with four or five principal plaits, and several smaller ones. Operculum (of *V. musica*) fusoid, narrowly elongated, with terminal nucleus. *V. musica*, Linn. (liii, 6).

HARPULA, Swains. Shell oval-conic, spire with a papilliform but small summit; columella with larger plaits below, and additional smaller ones above, but less numerous than in the preceding section; exterior lip thickened within, sharp without. *V. vexillum*, Lam. (liii, 7).

FULGORARIA, Schumacher, 1817. Shell oblong-fusiform; spire

moderately elongated, terminated by a papillary summit with the apex lateral, instead of central and vertical as usual in spiral shells; surface plicate longitudinally, crossed by engraved revolving lines; columellar plaits six or seven, or more; lip thickened within, its margin slightly crenulate. *V. rupestris*, Gmelin (liii, 8).

VESPERTILIO, Klein. Shell oval-oblong, more or less ventricose. Spire terminated by a regularly spiral summit, papilliform, but having an apparently crenulated nucleus, caused by the presence of numerous little tubercles, more or less apparent. Columella four-plaited. *V. vespertilio*, Linn. (liii, 9).

AULICA, H. and A. Adams. Agreeing with the preceding section in general form and principal characters, the summit of the spire differs in having a completely smooth instead of a tuberculated surface. *V. imperialis*, Lam. (liii, 10).

AMORIA, Gray. Shell fusiform, smooth and polished; spire conical, with a small, more or less pointed nucleus; sutures slightly callous; columella with five oblique, more or less developed plaits. *V. undulata*, Lam. (liii, 11).

ALCITHOË, H. and A. Adams. Shell oval-fusiform, spire elongated, terminated by a papilliform summit; aperture oval-elongated, inner lip covered by a callous deposit, outer lip expanded and more or less reflected; columella with four, and more rarely five to seven oblique plicæ. *V. Pacifica*, Solander (liii, 12).

CYMBIOLA, Swainson. Shell oval, thin, recalling the form of Cymbium. Spire more or less elongated, terminated by a slight irregular, papilliform summit. Aperture large, the columellar side covered with a slight coat of enamel; columella usually with four oblique plications; outer lip sharp, occasionally slightly expanded. An American, and principally Antarctic group. *V. ancilla*, Solander (liii, 13).

VOLUTELLA, d'Orbigny. Shell smooth, subcylindrical, with angulated whorls; spire acuminate, polished, and entirely covered by an enamel deposit, obliterating the suture-line more or less entirely; columella with three oblique plaits; lip sharp, not reflected. The development of a lobe of the mantle to cover the spire is a peculiarity in this animal not shared by the other groups of the genus. *V. angulata*, Swainson (liii, 14, 15).

PSEPHŒA, Crosse. Shell oblong-fusiform, very finely transversely striated and furnished with longitudinal ribs, disappearing towards the middle of the last whorl. Nucleus (?). Columella furnished with two principal plicæ, above which there are two or three minute ones hardly visible; it presents also this peculiarity (in the adult shell), that these plicæ are situated so far within as to be invisible when the shell is placed right in face of the

observer. Internal margin strongly callous; external lip obtuse and thickened. *V. concinna*, Brod. (liii, 16).

AUSOBA, H. and A. Adams. Spire short and obtuse, terminated by a papilliform summit; last whorl coronated. *V. cymbiola* (Chemn.), Sowb. (liii, 17).

VOLUTILITHES, Swains. Shell oval-fusiform, spire elevated, terminated by a pointed summit; whorls cancellated or longitudinally plicate; mouth oval-oblong; columella with numerous rudimentary or obsolete plicæ; lip thin. The group is represented by a single living species and numerous tertiary forms. *V. abyssicola*, Adams and Reeve (liii, 18).

VOLUTOCONUS, Crosse. Oblong, subcylindrical, longitudinally and transversely striate; spire short and obtuse, terminated by a rounded summit; columella with four slightly developed teeth; lip simple, slightly inflected in the middle; base with flexuous striæ. *V. coniformis*, Cox (liii, 19).

CALLIPARA, Gray. Shell oblong, subcylindrical; spire short, nucleus small; columella with two plications. *V. bullata*, Swainson (liii, 20).

MAMILLANA, Crosse. Shell widely oval, ventricose, rather thin, intermediate between *Voluta* and *Cymbium*; nucleus papilliform, very strongly developed, excentric and lateral; columella with a few oblique plicæ; lip thin. *V. mamilla*, Gray (liii, 21).

PROVOCATOR, Watson, 1882. Shell smooth, fusiform; having the apex of *Ancillaria*, the enameled suture of *Bullia*, the pillar-folds of *Voluta*, and the sinus of *Pleurotoma*. *V. pulcher*, Watson. Kerguelen Island.

WYVILLEA, Watson, 1882. Shell ovate, cymbiform, thin, rough; spire high scalar; apex mammillate and irregular; suture canaliculate; mouth large, ovate; inner lip with a wide-spread thinnish callus; pillar perpendicular, with a very slight turn, with no teeth, but an abrupt break of the edge about the middle of its length. Differs from *Cymbiola* in the texture of the shell, which is extremely delicate, but rough, in the canaliculate suture, and toothless pillar. *W. alabastrina*, Watson. Marion Island.

The following fossil groups are enumerated by W. M. Gabb. They should probably all be considered as subgeneric under *Voluta* rather than as distinct genera.

VOLUTODERMA, Gabb. Shape similar to *Fulgoraria*, which it also resembles more or less in surface-sculpture; apex not papillate; inner lip marked by from three to five well-marked folds, not very oblique, and of pretty uniform size. This is a group of shells characteristic of the cretaceous rocks and perhaps peculiar to them. They are all somewhat slender, and are marked by longitudinal ribs; the columella is always straight or nearly so, and the folds are as isolated and distinct as those of *Turbinella*.

But the most strongly distinguishing character is the entire absence of the irregularly rounded mass at the apex of the shell, one of the best characters of *Fulgoraria*. Cretaceous of United States, Europe and India. *V. Navarroensis*, Gabb. (liv, 26). California.

VOLUTOMORPHA, Gabb. Shell elongate, fusiform; whorls cancellated by longitudinal and revolving ribs; columella with one very oblique fold, and sometimes one or more smaller secondary folds. *V. Conradi*, Gabb (liv, 29). A cast. Cretaceous; New Jersey.

ROSTELLITES, Conrad. Narrow, subulate, with elongated spire, numerous subequal plaits on the columella, and the outer lip somewhat expanded anteriorly. *V. Texana*, Conr. (liv, 28). Cretaceous; Texas.

VOLUTIFUSUS, Conrad. (*Megaptygma*, Conr.) Fusiform; body-whorl finely striated or smooth, with the exception of the shoulder, which is sometimes tuberculated; columella plaited, folds two to three, sometimes very prominent, oblique; apex papillated; initial whorl acute, subspiral, narrow; beak produced, recurved or sinuous. Miocene of Europe and America. *V. typus*, Conrad (liv, 29). North Carolina.

ATHLETA, Conrad. Ovate, *Voluta*-shaped; spire short, acute; columella with plaits as in *Voluta*; a callus projecting on the shoulder, and covering a portion of the spire. Cretaceous; Miocene of Europe. *V. Tuomeyi*, Conrad (liv, 30). Mississippi.

LEIODERMA, Conrad. Shell largely covered with enamel; with very oblique columellar folds; outer lip somewhat emarginate on the upper part to its junction with the body-whorl; base deeply emarginate. *V. leioderma*, Conrad (liv, 31). Cretaceous; Mississippi.

PTYCHORIS, Gabb. Differs from *Athleta* in the want of the characteristic callus, in being subglobular instead of subfusiform and angulated, with very oblique folds on the anterior part of the columella. *V. purpuriformis*, Forbes (liv, 32). Cretaceous; India.

[**FICULOPSIS**, Stoliczka, referred by him to the *Volutidæ*, is a *Ficus* with the addition of columellar folds. I agree with Mr. Gabb in including it in the *Ficulidæ* = *Pyrulidæ*.]

PLEIOPTYGMA, Conrad. Subfusiform; aperture long; columella with very oblique plaits, numerous, alternated in size, or irregular; the largest being the second one from above. *V. Carolinensis*, Conrad (liv, 33). Miocene; South Carolina.

CRYPTOCHORDA, Mörch. Shell smooth, *Volutiform*, enameled; columella without plications. Tertiary. Seems to connect *Voluta* with *Harpa*. *V. stromboides*, Gmel. (liv, 34). Tertiary; France.

GOSAVIA, Stoliczka. Shell convolute, spire turbinated, last

whorl inversely conical; aperture narrowly elongate, base emarginate; lip sinuate at the suture; columella plicated, anterior plicæ strongest. Cretaceous; Europe and India.

Stoliczka refers this group to Conidæ, as he does also doubtfully Imbricaria and Cylindra, which he considers closely related. The two latter are known to be in no way closely related to Conus, and Gosavia possesses every characteristic of a Volute; indeed I cannot separate it readily from such forms as *V. musica*. *V. Indica*, Stol. (liv, 35). India.

LYRIA, Gray.

Distr.—16 sp. W. Indies, E. Africa, Indian Ocean, Japan, Australia, W. Coast of Central America. *L. Delessertiana*, Petit (liii, 22).

Shell ovately fusiform, solid; spire acuminate; whorls longitudinally ribbed; aperture ovate, rather narrow; columella with numerous transverse plaits, two lower ones much the largest; outer lip externally ribbed. Operculate.

The species are smaller than in *Voluta*, and *Mitræform*, connecting with the genus *Mitra*.

ENÆTA, H. and A. Adams. Outer lip thickened, inflected and bearing an obtuse tooth upon its middle inner margin. *L. harpa*, Barnes (liii, 23).

MICROVOLUTA, Angas.

Distr.—*M. Australis*, Angas (liii, 24, 25).

Shell small, ovately fusiform, solid, smooth, shining; spire as long as the aperture, apex papillary; whorls simple; aperture narrowly ovate; columella with four strong transverse plaits, the anterior one the smallest; outer lip thin, simple, slightly contracted at the base; base rounded, spout-shaped, with a flexuous bend upwards towards the columella, which is a little thickened and reflected below the plaits. The deep siphonal notch and the toothed projection of the base of the pillar, so characteristic of *Voluta*, are here wanting.

The above description is drawn up from the only known species, and probably many of its characters are of slight importance. The animal is unfortunately unknown.

FAMILY MITRIDÆ.

The animal has a small, narrow head; tentacles close together at the base; eyes near the base or towards the outer middle of the tentacles; proboscis cylindrical, flexible, very extensible, mantle enclosed; siphon simple at the base; foot small, triangular, usually truncate in front.

The dentition of the Mitridæ (x, 9) presents several distinct types; so that Troschel and Gill have divided the family upon

this character. The group *Cylindra* has the teeth of *Marginella* and is placed near that genus by these authors; the form of the shell also recalls *Marginellidæ*, and although the preponderance of characters accords with *Mitra*, it may be reasonably considered a connecting link with *Marginella*. *Volutomitra* has been placed in *Volutidæ* on account of the dentition of *V. Grænlandica*, the only Arctic species of *Mitra*, but I have preferred to retain it and its congeners in *Mitridæ*, because we know nothing of the dentition of numerous tropical species referred to it. *Turricula* and *Strigatella* are allied by their dentition to the *Olividæ*, and *Imbricaria* to the *Turbinellidæ*.

Some of the larger species have no operculum, but it is often present, though small and rudimentary, on the foot of the smaller species.

Shell with acute apex, usually well developed spire and plicate columella; for the most part destitute of epidermis, which is very thin, smooth and translucent when present.

Mitra is related on the one hand with *Voluta*, on the other with *Marginella*; it is distinguished from the former by its columellar plaits, of which the largest are posterior whilst in *Voluta* they are anterior, by its form, and the apex, which is never papillary; from *Marginella* it is distinguished by its much longer spire, less polished surface, generally larger size and particularly by wanting the thick marginal varix of the lip.

MITRA, Lamarck.

Syn.—*Thiarella*, Swains. *Mitraria*, Raf. *Mitrolites*, Krug. *Isara* and *Ziba*, H. and A. Ad.

Distr.—Over 200 sp. Tropical and subtropical, but a few small species being found in the colder latitudes. Bathymetrically they range from low-water to eighty fathoms, the smaller species being usually found along shore-lines. About a hundred fossil species have been described, commencing with the cretaceous period. *M. episcopalis*, Lam. (lv, 36).

Shell fusiform, thick; spire elevated; aperture small, narrow, notched in front; columella transversely, somewhat obliquely plicate; outer lip thick, smooth within, not variced externally.

The animal of *Mitra* has in general a very short foot, straight and continuous from side to side in some species, but in others notched and produced, with a thickened anterior margin. It is commonly narrow and rounded, or acuminate posteriorly, and it often bears a very small semitransparent horny operculum, in some instances scarcely visible. The siphon is mostly directed forward, and the somewhat short, tapering tentacles have the eyes either situated about half-way, or they are placed on the outer side of the base. The head is long and very flat, and the tentacles are very close together at their bases. The proboscis

is rarely exerted when they are crawling and lively, but as they become languid after capture it becomes distended with water and protrudes considerably. When irritated, some species of *Mitra* emit a purple fluid having a nauseous odor.

The Philippine Islands would seem to harbor the greatest number of these elegant and beautiful shells, although a great many species were obtained by Mr. Cuming in tropical America. They appear to be chiefly confined to the equatorial regions, scarcely any being natives of cold climates. The transversely ribbed species are frequently found in very deep water, and many have been dredged in twenty and thirty fathoms at the Sooloos and in the China Sea.

The Mitridæ inhabit various stations; many being strictly reef shells, where they lurk in holes and crevices under seaweed, but are most generally concealed under stones and blocks of dead coral. Others burrow in sand or sandy mud at various depths; some delight in stony ground inside the reefs, where they remain concealed under clumps of coral during the day, and like the sand species are nocturnal in their habits.

Although M. Quoy has rightly termed the *Mitra* an "animal apathique," the small longitudinally ribbed species crawl about pretty briskly over the smooth sand among the low coral islands. The *Mitra episcopalis* (lv, 36), probably on account of the small size of its locomotive disk, and the ponderous nature of its long shell, is, however, a very sluggish mollusk. Some of the Auricula-shaped Mitres that live among the Philippines, in the shallow pools left by the receding tide, crawl about the stones out of the water, in company with *Planaxis* and *Quoyia*. The Mitres, like many of the large Volutes, prefer, however, to associate together, and may be seen in dozens crawling over the sandy mud-flats in shallow water, being most active just as the flood-tide makes. When the tide recedes, they bury themselves superficially in the yielding soil, and are with difficulty discovered. Some of the small ribbed species cover themselves entirely with the sandy mud, and in that disguised condition travel about with comparative security.

MITRA (typical). Mitriform, thick, spire elevated, apex sharp; mouth rather small and narrow, notched in front; columella obliquely plicate; lip rather thick, smooth within.

[VOLUTOMITRA, Gray. Separated from *Mitra* on account of the peculiar dentition of an Arctic species, *V. Grænlandica*. Twenty additional species have been included in the group by H. and A. Adams; they are all Mitras in appearance, and the dentition of none has been examined, except that of *V. cornea*, which decidedly differs from *V. Grænlandica*, and is of the regular *Mitra* type.]

AIDONE, H. and A. Adams. Shell fusiform, smooth, polished,

small; spire acuminate, as long as the aperture; inner lip excavated, with two prominent plaits in the middle; outer lip thin, simple. *M. alba*, Pease.

SWAINSONIA, H. and A. Adams. (Mitrella, Swains.) Oliviform, smooth, polished, spire nearly as long as the aperture. *M. fissurata*, Lam. (lv, 37).

SCABRICOLA, Swainson. Mitre-shaped or pyramidal, granulated or scabrous. *M. granatina*, Lam. (lv, 38).

CANCELLA, Swainson. Shell fusiform, slender; whorls having revolving elevated ridges, and no longitudinal ribs; outer lip thin, not dentate within. *M. filosa*, Lam. (lv, 39).

CHRYSAME, H. and A. Adams. Shell ovate, spire and aperture usually about equal in length; whorls encircled by rounded ribs; inner lip with a few strong transverse plaits; outer lip with the margin crenate. *M. coronata*, Lam. (lv, 40).

STRIGATELLA, Swainson. (Mitreola, Sw.) Shell Columbelloform, smooth, uncolored or with brown longitudinal flames and maculations. *M. paupercula*, Lam. (lv, 41).

ZIERLIANA, Gray. Ovate or Columbelloform, solid; spire short, acute, last whorl tumid at the hind-part; columella with a posterior callosity; outer lip thick, flattened, lirate-dentate within; a sinus or short canal posteriorly. *M. robusta*, Reeve (lv, 42).

FUSIMITRA, Conrad. Uncharacterized. *M. cellulifera*, Conrad (lv, 43). Oligocene; Vicksburg, Miss.

CONOMITRA, Conrad. Uncharacterized. *M. fusoides*, Lea (lv, 44). Eocene; Claiborne, Ala.

THALA, H. and A. Adams.

Distr.—12 sp. Polynesia, Philippines, Mauritius, Panama. *T. mirifica*, Reeve (lv, 45).

Small, narrowly fusiform, sculptured or smooth, last whorl attenuated and recurved below; outer lip thickened, straight or incurved in the middle, lirate internally, with a slight sinus at the hind-part. Dentition unknown.

MITROIDEA, Pease.

Syn.—Mauritia, A. Ad. Mutyca, H. and A. Adams.

Distr.—6 sp. Polynesia, Philippines, Mauritius. *M. ancillides*, Swains. (lv, 46).

Shell mitriform, smooth, spire acuminate; aperture narrow, linear; columella with numerous, small oblique plaits, narrowed and turned to the left at the base; outer lip thickened, peculiarly truncated and recurved at the base. Dentition similar to that of Mitra.—MACDONALD.

Mitroidea is closely allied to Dibaphus, but the latter has a shorter spire, and is without columellar folds.

DIBAPHUS, Philippi.

Distr.—*D. Philippii*, Crosse (lv, 47). Polynesia, Mauritius.

Subcylindrical, covered with a thin epidermis, transversely sculptured; spire acute; aperture narrow, linear; columella without plaits, narrowed and turned to the left at base; outer lip thickened, rectilinear, abruptly truncated and recurved at the base.

Differs from *Mitroidea* in the columella being without plaits. It resembles in general form *Conus mitratus*, as well as more distantly *Strombus terebellatus*, and formerly had a position between *Conus* and *Mitra*, but the animal does not differ from *Mitra*. Like that genus, when plunged living into alcohol it yields a fine purple dye.

TURRICULA, Klein.

Syn.—*Callithea*, Swains. *Vexillum*, Bolt. *Tiara*, Swains. *Vulpecula*, Blainv.

Distr.—162 sp. Exclusively tropical and subtropical, its metropolis being Central Polynesia. *T. plicaria*, Linn. (lv, 48).

Shell elongated, turreted, longitudinally plicately ribbed; spire acuminate; aperture narrow; columella with numerous plaits; outer lip internally striated.

COSTELLARIA, Swainson. Shell smaller, with elevated spire, body-whorl anteriorly contracted, slightly ventricose in the middle, aperture sometimes striated within. *T. exasperata*, Chemn. (lv, 49).

PUSIO, Swains. Shell small, ovate, more or less ribbed or nodulous, spire usually short, convex, with obtuse apex; outer lip sometimes thickened. *T. luculenta*, Reeve (lv, 50).

LAPPARIA, Conrad. Uncharacterized. *T. dumosa*, Conrad (lv, 51). Eocene; Jackson, Miss.

CYLINDRA, Schum., 1817.

Distr.—8 sp. Red Sea, Indian Ocean, China, Philippines, Polynesia, Mauritius. *C. fenestrata*, Lam. (lv, 52).

Shell oliviform, subcylindrical; spire conical; aperture linear; columella straight, with several oblique anterior plaits; outer lip thickened, smooth within.

IMBRICARIA, Schum., 1817.

Syn.—*Conœlix*, Swains.

Distr.—9 sp. Philippines, Polynesia. *I. marmorata*, Quoy (lv, 53).

Shell coniform, often covered with an epidermis; spire depressed conical, apex mucronate; aperture linear; columella straight, with numerous transverse imbricated plaits in the middle; outer lip thickened.

Distinguished by its Conus-like form, the columella with less numerous plaits than in most of the species of *Cylindra*; some species, like *Cylindra dactylus*, however, appear to connect these two forms.

FAMILY MARGINELLIDÆ.

Shell porcellaneous, polished, usually smooth or with longitudinal ribs; spire short or immersed, body-whorl ample, aperture nearly the length of the shell, the outer lip with usually thickened margin, smooth or dentated within, the inner lip with several distinct plaits on the columella.

Animal with tentacles close together at the base, the eyes above the base or near the middle of the tentacles, mantle with expanded side-lobes covering the back of the shell as in *Cypræa*; siphon elongate, foot large, truncate in front, produced behind. Operculum none.

Dentition (\propto , 6). In possessing rhachidian pieces without laterals, the lingual armature of *Marginella* resembles that of *Voluta*, whilst the shape of the plate and its dentated edge are very similar to that of *Mitridæ*—lateral teeth being added in the latter family. A single species of *Erato* (the only one examined) possesses three lateral teeth on each side like the *Cypræidæ*, and on this ground some systematists place *Erato* in that family. *Marginella glabella* sometimes possesses an operculum, but generally does not have it; some of these operculate specimens also have a single lateral tooth on each side of the rhachidians on the lingual ribbon. *Pseudomarginella*, *Carriere*, is founded upon specimens possessing this very different dentition; the shell does not differ at all from specimens of *M. glabella* in which the dentition is normal.

The shell being covered by the mantle-lobes receives a polished surface and is devoid of epidermis, thus resembling externally the Cowries and Olives, whilst the plaits on the columella connect the family with *Mitridæ*.

ERATO, Risso.

Distr.—17 sp. Europe, West Indies, So. Africa, Indian Ocean, Philippines, Polynesia, Tropical W. America. Fossil. Eocene—; Europe. So. Australia, N. America. *E. lævis*, *Donov.* (lv, 54).

Shell obovate, polished; spire short, conical, distinct; aperture linear; outer lip without varix, but thickened towards the middle, and denticulated within; columella with distinct plaits at the fore-part.

ERATOPSIS, Høernes and Auinger. Shell granular-tuberculate, with a longitudinal sulcus on the back of the body-whorl, as in *Trivia*. Includes five living species, and several forms from the Austrian tertiary. *E. Schmeltziana*, *Crosse* (lv, 55).

MARGINELLA, Lamarck.

Etym.—Diminutive of Margo, a rim.

Syn.—Volvarina, Hinds. Eratoidea, Weink. Egouena and Serrata, Jousseau. Bullata, Jous. Granula, Jous. Canalispira, Jous. Balanetta, Jous. Porcellanella and Microspira, Conr. Pseudomarginella, Carriere, 1881.

Distr.—200 sp. Tropical and subtropical; Caribbæan, West African, Indo-Pacific, etc. Fossil, 75 sp. Cretaceous (?), Eocene—; United States, Europe, Australia. *M. glabella*, Linn. (lv, 56).

Shell ovately oblong to subcylindrical, smooth, polished, sometimes longitudinally ribbed; spire short-conical or concealed; aperture narrow, elongated, obtuse or truncated in front; columella plicate; outer lip with a thick marginal varix, its inner margin smooth or crenulated.

GLABELLA, Swainson. Volutiform, spire more or less conic, well developed, usually longitudinally plaited about the shoulder of the body-whorl; pillar with distinct basal plaits; lip thick, toothed or crenate, rarely smooth within. *M. Adansonii*, Kiener (lv, 57).

PRUNUM, H. and A. Adams. Shell smooth, oval, spire slightly prominent; outer lip thick, unarmed, inner lip frequently forming a callous deposit; color light gray or yellowish gray, usually without distinct bands or spots; exterior lip-margin sometimes orange-brown. *M. marginata*, Born (lv, 59, 60).

CRYPTOSPIRA, Hinds. Shell swollen, smooth, spire very short, nearly concealed; columella five- or six-plaited; outer lip thickened, smooth within; color gray or yellowish olivaceous, usually without bands, sometimes interruptedly banded or strigate. Nearly related to Prunum, but differs in having a shorter spire, less callous deposit and more columellar teeth or plaits. *M. elegans*, Gmel. (lv, 58).

VOLUTELLA, Swainson. Bulliform, ovate-oblong; spire depressed; pillar with four oblique plaits at the fore-part, lip smooth within. *M. bullata*, Born (lv, 61).

PERSICULA, Schum. Shell Bulliform, spire depressed or sunken; usually banded or spotted; aperture long, the outer lip generally denticulated within, with a posterior channel, inner lip with a callosity posteriorly, four plaits anteriorly, with smaller ones behind them, becoming obsolete. *M. persicula*, Linn. (lv, 62).

GIBBERULA, Swainson. Shell suboval; spire slightly prominent, outer lip posteriorly dilated and gibbous, not denticulated. A group of small species differing from Persicula in the spire being slightly prominent instead of sunken. *M. miliaria*, Linn.

CLOSLIA, Gray. Spire involute; lip thick, usually dentate within; columella heavily incrustated with callus, the two lower plaits very prominent, two upper ones not so prominent, above them there are sometimes false folds or transverse ridges as in

Cypræa. The dorsal aspect is much like Cypræa. *M. sarda*, Kiener (lv, 63).

VOLVARIA, Lam. (Hyalina, Schum.) Shell subcylindrical, spire very short or concealed; outer lip of aperture without varix or thickening. *M. avena*, Gmel. (lv, 64). *M. bulloides*, Lam. (lv, 65).

FAMILY OLIVIDÆ.

Animal with a recurved siphon and voluminous foot, its lobes usually reflexed over the sides of the shell, and fissured on each side in front. Dentition (x, 15).

Operculum corneous, small; frequently wanting.

Shell brilliantly colored, porcellaneous, without epidermis, the columellar lip, sutures and spire more or less covered with a callous deposit; outer lip simple, notched below.

SUBFAMILY OLIVINÆ.

Head and tentacles more or less concealed; mantle with a tapering lobe in front, and a posterior appendage which reposes in the channeled suture.

Operculum present in Olivella, absent in the typical Oliva.

Shell solid, smooth, subcylindrical, sutures channeled, inner lip more or less plicate anteriorly.

OLIVELLA, Swainson.

Rice-shell. *Syn.*—Olivina, d'Orb. Micana, Gray.

Distr.—31 sp. N. Carolina, W. Indies, W. Coast of America, Senegal, China, Philippines, Australia, Polynesia. *O. undatella*, Lam. (lvi, 66).

Shell polished, small; spire produced, acute, suture canaliculated; aperture narrow behind, enlarged anteriorly; columella plicated in front, callous posteriorly.

Animal without tentacles or eyes, mantle with a large frontal lobe; foot not very voluminous, truncate behind, the shield narrow, the side-lobes small and acute.

Operculum horny, thin, half ovate, with apical nucleus.

Olivella is distinguished from Oliva by the small size of its shell, its more produced spire, the presence of a large, thin, horny operculum, and the want of eyes. D'Orbigny has observed *O. Tehuelcha* suddenly expand the lobes of its foot, and using them to beat the water like the wings of the pteropods, dart rapidly through the element.

OLIVA, Brug.

Syn.—Dactylidia, H. and A. Ad. Ispidula, Gray. Porphyria, Bolten. Strephona, Browne. Dactylus, Klein. Galeola and Carmione, Gray.

Distr.—55 sp. Subtropical; East and West America, W. Africa, India, China, Polynesia. Fossil. Eocene—. *O. erythrostoma*, Lam. (lvi, 67).

Shell oblong, subcylindrical, polished; spire short, conic; suture canaliculated; aperture long and narrow, anteriorly widely notched; columella obliquely plicate, sulcate or striate in front, posteriorly callous; outer lip simple.

Animal with tentacles enlarged at the base; mantle with a posterior filament lodged in the channeled suture of the spire; foot long and acuminate behind, shield with the side-lobes tapering, acute, small.

Operculum none, in the restricted group.

Like most shells enveloped in the voluminous foot of the animal, *Oliva* has no epidermis. The shell has an under layer with different pattern of coloring, but this is never exposed except in worn specimens, or else artificially by the aid of acids: hence it is evident that unlike the *Cypræa*, which changes its pattern upon becoming mature, the two layers of *Oliva* are simultaneously produced at all stages of its growth. The interior volutions are often absorbed till they become of paper-like tenuity in order to accommodate the increasing bulk of the animal.

LAMPRODOMA, Swainson. (*Ramola*, Gray.) Spire acuminate, elevated, suture canaliculated; inner lip simple posteriorly, but regularly, numerous plicate anteriorly, the plicæ more transverse than in the typical group. *O. volutella* (lvi, 68—the only species) is found in vast numbers over many acres on the sandy beach west of the city of Panama. Some time after the retreat of the tide, it is found crawling about with much vivacity on the wet sand. The shell, while the animal is moving, is wholly covered with the foot-lobes, and these are entirely concealed with a thick coat of sand. When the first wave of the returning tide strikes them, washing off this coating, they instantly bury themselves.

CALLIANAX, H. and A. Adams. (*Scaphula*, Gray.) Shell swollen, ovate, with short conical spire and channeled sutures; aperture wide, effuse in front; inner lip with a very thick, defined callus, and a few frequently indistinct anterior plaits. 2 sp. W. Coast of America, Patagonia. *O. biplicata*, Sowb. (lvi, 69).

AGARONIA, Gray. (*Tortoliva*, Conr. *Hiatula*, Swains.) Shell thin, oliviform, but a little effuse anteriorly; spire acuminate; aperture rather wide, effuse below; columella not thickened posteriorly, tumid, with a few oblique plaits in front. Has a small operculum. *O. hiatula*, Lam. (lvi, 70).

OLIVANCILLARIA, d'Orb. (*Utriculina*, Gray. *Lintricula*, H. and A. Adams. *Scaphula*, Swains. *Anazola* and *Clanophila*, Gray.) Shell smooth, wide, oblong, last whorl swollen; spire

very short, the suture not canaliculated to the apex; aperture rather large and wide, inner lip somewhat tortuous, with a large callosity behind, incurved in the middle, and two or three oblique anterior plaits. Head and tentacles concealed; mantle with a large, thick, fleshy appendage behind, partially covering the spire; foot very voluminous, truncate posteriorly, shield with the side-lobes very large and rounded. Operculum small, half ovate, with subapical nucleus. Appears to connect Oliva with Ancillaria. Brazil, W. and S. Africa. *O. Brasiliana*, Lam. (lvi, 71).

PLOCIHELÆA, Gabb. Shell olive-shaped, suture nearly obsolete, as in *Ancillaria*; spire short; outer lip internally thickened in the middle; inner lip callous, with several transverse folds, of which the upper are smallest; columella strongly recurved at the base, like a *Dibaphus*. *P. crassilabra*, Gabb. Tertiary; West Indies.

SUBFAMILY ANCILLARIINÆ.

Head concealed; eyes none; tentacles rudimentary; mantle with a tapering lobe in front; foot voluminous, bifid behind, shield-grooved on the upper surface, side-lobes not much produced. Operculum small, ovate, acute, sometimes entirely wanting. Shell usually polished; sutures covered by callus; whorls smooth; aperture effuse, the columella variously grooved and twisted in front.

MONOPTYGMA, Lea.

Syn.—Not *Monoptygma*, Gray. *Chiloptygma*, H. and A. Ad.

Distr.—Fossil. Eocene; United States. *M. Alabamensis*, Lea (lvi, 74). One recent species, *M. exigua*, Sowb., is possibly a monstrosity.

Shell with elevated spire and callous columella, the latter with a subcentral conical tooth-like callous projection. Dr. Lea's second species of his genus is an *Actæon*.

ANCILLARIA, Lam.

Etym.—*Ancilla*, a maiden.

Syn.—*Ancillopsis*, Conr. *Sparella*, Gray. *Anaulax*, Roissy. *Ancilla*, Lam. *Amalda*, H. and A. Adams. *Sandella* Gray.

Distr.—17 sp. Red Sea, Indian Ocean, Australia, Japan, West Indies. Fossil. Eocene—; U. S., Eur. *A. Tankervillei*, Swains. (lvi, 73).

Shell oblong or subcylindrical, thick and smooth in the typical species; body-whorl usually swollen; sutures covered by enamel; aperture broadly effuse below; columella (typically) not umbilicated, with a few oblique anterior plaits. The revolving basal groove ends occasionally in a slight anterior labral projection or tooth.

OLIVULA, Conrad. Shell decussated by distinct close, longitudinal and revolving striæ; spire covered by a longitudinally striate callous deposit, forming a raised band upon the suture of the body-whorl; aperture posteriorly channelled. Fossil only. *A. staminea*, Conr. (lvi, 72).

ANOLACIA, Gray. (*Cymbancilla*, Fischer.) Shell oblong-ovate, thin; body-whorl swollen, irregularly covered with slight revolving striæ; spire very short, callous. Somewhat resembles the genus *Cymbium*. *A. Mauritiana*, Sowb. (lvi, 75).

DIPSACCUS, Klein. Shell solid, polished; columellar lip twisted, separated from the body-whorl by a tortuous fissure opening into the umbilicus above; outer lip with a slight tooth in front. *A. glabrata*, Linn. (lvi, 76).

ANCILLINA, Bellardi, 1882. Spire produced, body-whorl rather short; on all the whorls is a narrow channel close to the suture; columella uniplicate. *A. pusilla*, Fuchs. Tertiary; Northern Italy.

ANCILLARINA, Bellardi, 1882. Shell narrowly elongated, sub-cylindrical, with short spire; anterior area defined by an oblique sulcus which terminates in a tooth on the outer lip. *A. suturalis*, Bon. 2 sp. Tertiary; Northern Italy.

SUBFAMILY HARPINÆ.

Head and tentacles exposed; eyes conspicuous; mantle simple, enclosed, without a tapering appendage in front; foot large, flat, not reflexed on the sides of the shell. No operculum. Shell large, ventricose, longitudinally ribbed; columellar lip without anterior plications or grooves. Dentition (x, 16).

HARPA, Lam.

Harp-shell.

Syn.—Harpalis, Link. Harparia, Raf. Lyra, Griffith.

Distr.—9 sp. Tropical; Mauritius, Philippines, Ceylon, Polynesia, West Coast of America (absent from the tropical Atlantic O.). Fossil. Eocene.—*H. ventricosa*, Lam. (lvi, 77).

Generic characters, those of the subfamily.

The figure (x, 16) of the dentition is copied from Troschel, and is from a quite young individual. The lingual ribbon is, in this genus, very minute compared with the size of the animal. Troschel was not able to detect any lateral teeth, but Macdonald, who only observed them towards the posterior extremity, records that they are very similar to those of *Oliva*. Other observers have not found a trace of lingual armature, and it is possibly only developed in the young animal. The animal of *Harpa* is variegated with beautiful colors. It crawls with vivacity. The front of the foot is crescent-shaped, and divided by deep lateral fissures from the posterior part. Unable to withdraw completely

within its shell, it is said, when irritated, to spontaneously detach a portion of this foot.

SILIA, Mayer, 1876. Ribs deflected, spire short, suture not deep. *H. Zitteli*, Mayer. Eocene.

HARPOPSIS, Mayer, 1876. (*Buccinopsis*, Bayle.) Shell smooth, the last whorl slightly angulated below the suture, very large and long; mouth small, lengthened; inner lip with thin callus; outer lip with slight posterior sinus. *H. stromboides*, Lam. Eocene; Paris basin.

FAMILY COLUMBELLIDÆ.

Shell oval, covered by an epidermis; spire more or less developed, generally short; aperture narrow, elongated, terminating in a very short anterior canal; columellar lip usually dentate; outer lip mostly thick, incurved in the middle and internally crenulated. Animal with a large, flattened head; the foot narrow, oval, elongated; the siphon scarcely longer than the canal of the shell. Operculum very small, lamellar, corneous. Dentition (x, 20).

COLUMBELLA, Lam., 1799.

Etym.—Diminutive of *columba*, a dove.

Syn.—Columbus, Montf., 1810. Peristera, Rafinesque, 1815. Pygmæa (Humphrey), Mörch, 1858.

Distr.—300 sp. Mostly subtropical; Atlantic Coast, U. S., West Indies, Mediterranean, India, China, Japan, Philippines, Australia, Polynesia, W. Coast of America. Fossil. Tertiary. *C. mercatoria*, Lam. (lvi, 78).

Shell strombiform or obovate, smooth or longitudinally or transversely ribbed; internal lip excavated in the middle, crenulated or denticulated in front; outer lip inflected and internally thickened and crenulated in the middle.

NITIDELLA, Swainson, 1840. Shell oval, smooth, spire elevated; aperture somewhat effuse below; columella with two small anterior plications, outer lip somewhat thickened. *C. nitida*, Lam. (lvi, 79).

ALIA, H. and A. Adams, 1853. Shell thin, smooth, spire moderate; aperture oval; inner lip finely crenulated, outer lip thick, not callous in the middle, striate within. *C. unifasciata*, Sowb. (lvi, 80).

MITRELLA, Risso, 1826. Shell mitriform, smooth, spire elevated; columella smooth or with a few anterior rugosities; outer lip smooth, or crenulated within. *C. lactea*, Duclos (lvi, 81).

ATILIA, H. and A. Adams, 1853. Shell fusiform, longitudinally plicate; spire elevated, sharp; last whorl suddenly narrowed in front. *C. suffusa*, Sowb. (lvi, 82).

ANACHIS, H. and A. Adams, 1853. Shell oval-fusiform, longitudinally ribbed; spire elevated; aperture narrow; columella

straight; outer lip nearly straight, crenulated within. *C. rugosa*, Sowb. (lvi, 83).

SEMINELLA, Pease, 1867. (Cytharopsis, Pease, 1867.) Shell small, fusiform, longitudinally costate; lip slightly emarginate above, lirate or denticulate within. *C. gracilis*, Pease (lvi, 84).

MITROPSIS, Pease, 1867. Shell fusiform, longitudinally more or less costate or plicate; aperture narrow; lip dentate, sinuate above; columella callous, plicate. Described as a group of Mitridæ, but appears to be more nearly related to the Columbells. *C. fusiformis*, Pease (lvi, 95).

CONIDEA, Swainson, 1840. (Pyrene [Bolten], H. and A. Ad., 1853. Conella, Swainson, 1840.) Shell fusiform; inner lip reflected in front; outer lip crenulated within. *C. tringa*, Lam. (lvi, 85). *C. Philippinarum*, Reeve (lvi, 86).

META, Reeve, 1859. (Conella, H. and A. Adams, not Swainson, 1853.) Shell conoid, regularly attenuated towards the base, spire rather short, generally superficially channeled; aperture elongated, narrow, interior with revolving short ridges near the margin. 6 sp. So. Africa, W. Indies, Java, Philippines. *C. coniformis*, Sowb. (lvi, 94).

STROMBINA, Mörch, 1852. Shell fusiform, turriculated; spire sharp; whorls gibbous, nodulous; inner lip with a rather thick callus; outer lip thick, sometimes sinuous behind; anterior canal well-formed. *C. lanceolata*, Sowb. (lvi, 87).

AMYCLA, H. and A. Adams, 1853. Shell bucciniform, smooth, solid; aperture oval; columella smooth, truncated in front; outer lip arcuated, crenulated within. *C. dermestoidea*, Lam. (lvi, 88).

ASTYRIS, H. and A. Adams, 1853. Oval-fusiform, smooth or transversely striated; aperture oval; inner lip smooth, not callous; outer lip sinuous posteriorly, crenulated within. *C. Clausiliæforme*, Kiener (lvi, 89).

ÆSOPUS, Gould, 1860. Shell fusiform, gibbous, broadly truncate in front; aperture lunate, with a posterior callus on the body; columella smooth, vitreous; suture abnormally arcuate near the aperture. Animal white; foot emarginate in front, obtuse behind, bearing a corneous flabelliform operculum; head small; tentacles short, broad, eyes in the middle; siphon wide, short. Said to be intermediate between Columbella and Mitra. *Æ. Japonicus*, Gould.

ENGINA, Gray, 1839.

Distr.—45 sp. Tropical; Indo-Pacific, Polynesia, Panama, West Indies, etc. *E. trifasciata*, Reeve (lvi, 90).

Shell ovate-conic; spire sharp, with longitudinal nodulous ribs, decussated by revolving lines; aperture narrow, with several oblique plications in front; outer lip rather thick, inflected or callous in the middle, crenulated within.

FUSIOSTOMA, Swainson, 1840. Shell ovate; inner lip granulose;

outer lip greatly thickened in the middle and denticulated. *E. mendicaria*, Lam. (lvi, 91).

ALCIRA, H. Ad., 1860.

Distr.—*A. elegans*, Ad. South Africa.

Shell fusiform, thin; spire produced; whorls transversely striated; aperture ovate; columella truncate, with a single oblique fold anteriorly; outer lip thin, smooth internally, expanded at the hind-part, and with the anterior margin crenulated. Differs from other groups in its expanded lip, which is not thickened, and from most others in the columellar fold.

COLUMBELLINA, d'Orb., 1843.

Syn.—*Zittelia*, Gemmellaro, 1870.

Distr.—4 sp. Cretaceous; France, India. *C. ornata*, d'Orb. (lvi, 92). 1 sp. Recent.

Shell oval, thick, ventricose; aperture narrow, flexuous, narrowed in the middle, ending posteriorly in a prolonged lateral canal; outer lip much thickened and smooth within.

COLUMBELLARIA, Rolle, 1861.

Distr.—Upper Jura; Europe. *C. corallina*, Quenst. (liv, 35a).

Shell long-oval; body-whorl rather inflated; spire moderate; aperture wide below; outer lip rounded, not inflected in the middle, with strong revolving ribs within; columellar callus thin, showing the sculpture of the body-whorl.

AMPHISSA, H. and A. Ad., 1853.

Distr.—2 sp. West Coast of North America. *A. corrugata*, Rve. (lvi, 93).

Shell bucciniform, longitudinally ribbed; spire elevated; aperture rather wide, enlarging below and terminating in a wide anterior sinus; inner lip callous, plicate below; outer lip not thickened on the margin, plicate within.

FAMILY CANCELLARIIDÆ.

Shell ribbed, cancellated by revolving lines; mouth produced or angulated in front; columella plicated, outer lip ribbed within. Teeth shaped somewhat like those of the family Conidæ, arranged in two rows; the head does not seem to be elongated, the rostrum being rudimentary. There is no operculum.

CANCELLARIA, Lam.

Etym.—*Cancellatus*, cross-barred.

Distr.—70 sp. West Indies, Mediterranean, West Africa, India, China, W. Coast of tropical America. Fossil, 60 sp.

Commencing with the Upper Cretaceous. *C. cancellata*, Linn. (lvii, 96).

Shell oval, cancellated, reticulated or ribbed; last whorl ventricose; aperture oblong, canaliculated in front, canal short, sometimes recurved, columella with several large oblique plications.

The Cancellariæ are vegetable feeders, ranging from low-water to 40 fathoms.

TRIGONOSTOMA, Blainv. Shell conic-oval, widely umbilicated; whorls angular or babylonian, longitudinally ribbed; aperture triangular, angulated in front. *C. tuberculosa*, Sowb. (lvii, 97).

APHERA, H. and A. Adams. Shell oval, not umbilicated; columella and inner margin of aperture widely covered with callus. *C. tessellata*, Sowb. (lvii, 98).

EUCLIA, H. and A. Adams. Shell pyriform, not umbilicated; spire very short; whorls smooth; columella with large anterior plications. *C. solida*, Sowb. (lvii, 99).

MERICA, H. and A. Adams. Shell oval, spire sharp; whorls reticulated; aperture oblong, not channeled in front; columella with oblique plications; internal lip callous, exterior lip sharp. *C. elegans*, Sowb. (lvii, 100).

NARONA, H. and A. Adams. Shell oval, fusiform; spire elevated, sharp; whorls sharply ribbed; aperture oblong, canaliculated in front; the columella plicate, posterior rib the largest; outer lip crenulated. *C. clavatula*, Sowb. (lvii, 1).

MASSYLA, H. and A. Adams. Shell oval, turbinated, spire obtuse; whorls transversely striated; aperture reflected and channeled in front; columella truncated. *C. corrugata*, Hinds (lvii, 2).

TURBINOPSIS, Conr. Columella with a single very oblique fold near the basal margin. *C. Hilgardi*, Conr. (lvii, 3).

MOREA, Conrad. Short, elliptical; aperture much longer than the spire; columella reflexed, concave, with a prominent acute fold at the base. *M. cancellaria*, Conr. (lvii, 4). Cretaceous; Miss.

BABYLONELLA, Conr., 1865. Uncharacterized. 11 sp. Eocene. *C. elevata*, Lea. Claiborne, Ala.

ADMETE, Moller.

Distr.—*A. viridula*, Fabr. (lvii, 5).

Shell oval, thin, diaphanous, covered by a thin epidermis; spire sharp; last whorl ventricose; aperture oval, feebly channeled in front; columella arcuated, obliquely truncated, with rudimentary plications; outer lip sharp.

This small group represents Cancellaria in boreal seas in the same manner that Trophon replaces Murex and Bela does Mangelia.

ADMETOPSIS, Meek, 1872. Lower fold of columella most distinct, whilst the second fold is the most prominent in Admete; inner lip thickened throughout. 3 sp. Cretaceous; Utah. *A. gregaria*, Meek (lvii, 6).

[Genus PURPURINA, Lycett. This group of fossil shells, which I have placed in the Purpurinæ, is by others referred to Cancellariidæ.]

FAMILY TEREBRIDÆ.

The Terebras are known by their long, narrow, many-whorled shells, with small aperture, notched in front, and no true columellar plaits. The animal has a foot rounded in front, elongated behind; the head is large, with short, small tentacles; eyes at or near the tips of the tentacles, or wanting; between the tentacles extends a rather long cylindrical trunk. Operculum annular, horny, with apical nucleus.

TEREBRA, Lam.

Auger-shell.

Syn.—Terebraria, Raf. Acus, Humphrey. Dorsanum, Gray. Pyramitra, Cœlatura and Terebrifusus, Conr.

Distr.—About 200 sp. Mostly tropical; East Indies, West Coast America, etc. Fossil, 25 sp. Commencing with Eocene.

Shell elongated, turriculated, narrow, solid; whorls numerous, rather flattened, with superficially impressed sutures; aperture small, ovate, profoundly notched at the base; columella oblique.

SUBULA, Schum. Whorls smooth, aperture not produced. *T. maculata*, Linn. (lvii, 7).

ABRETIA, H. and A. Adams. Whorls longitudinally ribbed, aperture a little produced in front. *T. cerithina*, Lam. (lvii, 8).

HASTULA, H. and A. Adams. Whorls usually smooth, columella simple, a little produced in front. *T. strigillata*, Linn. (lvii, 9).

EURYTA, H. and A. Adams. Shell smooth or slightly ribbed, turriculated; last whorl somewhat ventricose; aperture large; columella produced in front, a little twisted. *T. aciculata*, Lam. (lvii, 10).

TEREBRA, Adanson. Shell much elongated, subulate; whorls very numerous, rather flat with a spiral band revolving beneath the sutures; aperture small, canaliculate. *T. cingulifera*, Lam. (lvii, 11).

MYURELLA, Hinds. Shell much elongated, subulate; whorls numerous, ribbed with a band of tubercles below the sutures. *T. nebulosa*, Sowb.

PUSIONELLA, Gray.

Syn.—Netrum, Phil.

Distr.—W. Africa, etc. *P. nifat*, Adans. (lvii, 12).

Shell fusiform or turriculated, oblong-oval, smooth; aperture oval-elongated, large, produced into a twisted canal in front; columella carinated, anteriorly twisted, with a small basal plication.

FAMILY PLEUROTOMIDÆ.

Shell fusiform, canaliculated, outer margin of aperture with a slit near the suture. Operculum corneous, annular, not always present. Animal with tentacles wide apart, the eyes at their outer bases.

PLEUROTOMA, Lam.

Etym.—*Pleura*, the side, and *toma*, a notch.

Syn.—Turris, Humph. Cochlespira, Conrad. Gemmula, Weink. Eucheilodon, Gabb.

Distr.—Over 500 sp. World-wide; low-water to 100 fms. Fossil, nearly as many. Cret.—*P. babylonica*, Lam. (lvii, 13).

Shell turriculated, fusiform, terminated anteriorly by a straight, more or less long canal; aperture oval, columellar lip smooth, straight or sinuous; outer lip somewhat sinuous, with a posterior sinus.

SURCULA, H. and A. Adams. Turriculated, internal lip obsolete; canal long, narrow, slightly twisted. *P. nodifera*, Lam. (lvii, 14).

SURCULITES, Conrad. Shell with spire and body-volution nearly equal; the latter obconical, rectangular near the top, and flattened or concave above from the angle to the suture; sinus of lip above the angle of the whorls, shallow and broad. *S. annosa*, Conrad. Mr. Conrad never characterized it; but his type-species has the characters given above. It seems to be very near to Surcula but may probably be retained for a group of Tertiary species, with obconic body-volutions, usually referred to Pleurotoma, and forming a kind of transition toward the Conidæ (Meek).

GENOTA, H. and A. Adams. (Pseudotoma, Bellardi. Cryptoconus, Koen. Dolichotoma, Bellardi. Roualtia, Bell.?) Shell mitriform; whorls finely cancellated; aperture elongated, canal short; sinus profound. *P. Mitræformis*, Kiener (lvii, 15).

BRACHYTOMA, Swains. Shell strombiform; columellar lip rather thick; outer lip ascending and forming a sinus or narrow canal near the suture. *P. Stromboides*, Sowb. (lvii, 16).

CONOPLEURA, Hinds. Shell coniform; aperture narrow, sinuous; columellar lip callous; canal very short; outer lip sinuous, with a profound lateral sinus. *P. striata*, Hinds (lvii, 17).

DRILLIA, Gray. (Moniliopsis, Conrad.) Turriculated; aperture oval, oblique; canal short, twisted; columellar lip strongly callous above. Animal with approximate tentacles and eyes at their extremity. *P. gibbosa*, Kiener (lvii, 18).

CRASSISPIRA, Swains. Shell somewhat claviform, tuberculated;

scarcely any anterior canal; internal lip with a thick posterior callus; external lip thick within. *P. pulchra*, Gray (lvii, 19).

CLAVUS, Montf. Tuberculated or spiny; aperture rather large; internal lip smooth; outer lip produced below the sinus. *P. auriculifera*, Lam. (lvii, 20).

ANCISTROSYRINX, Dall. (Candelabrum, Dall.) Shell with the posterior surface of the whorls concave, with a broad deep sinus, bordered externally by a pectinated elevated frill, directed backwards. *P. elegans*, Dall. West Indies.

BELA, Gray. Shell oval, fusiform, thin; spire produced; canal short; sinus small, near the suture; columella flattened; operculum pointed at both ends. Northern. *P. turricula*, Montf. (lvii, 21).

BELOMITRA, Fischer, 1882. Shell like Bela, but with numerous plicæ on the columella. *B. paradoxa*, Fischer. Atlantic O., 627 mètres.

LACHESIS, Risso. (Anna and Nesæa, Risso. Atoma, Bellardi?) Turriculated, with convex whorls and mamillated apex; lip-sinus obsolete; operculum unguiform. Animal with converging tentacles, short siphon and short ovate foot. *P. minima*, Montf. (lvii, 22).

CLAVATULA, Lam. (Clavicantha, Swainson. Mesochilostoma, Seely?) Subfusiform; spire produced; whorls coronated; aperture oval; canal short; columella smooth, sinuous; lip-sinus profound. *P. imperialis*, Lam. (lvii, 23).

CLIONELLA, Gray. Shell fusiform, longitudinally ribbed; last whorl usually contracted in front; a more or less developed anterior canal; and posterior sinus. South Africa. A Melania-like shell, usually classed with Pirena, etc., and erroneously supposed to inhabit fresh waters. The eyes are placed near the tips of the tentacles, the foot is broad and very short. Operculum subelliptical with the nucleus near the middle of the inner side. Dentition, 1·1·1. *P. buccinoides*, Lam. (lviii, 24).

PERRONA, Schum., 1817. (Tomella, Swains.) Shell fusiform, subclaviform; spire more or less elevated, smooth or carinated; aperture somewhat narrow, terminating in a rather long canal; inner lip callous near the suture. *P. lineata*, Lam. (lviii, 25).

CLINURA, Bellardi. Ovately fusiform or turreted; sinus deep; arcuate; lip greatly produced anteriorly, aliform; columella contorted; canal rather long, oblique. *P. Calliope*, Brocchi (lviii, 27).

CLATHURELLA, Carp. (Defrancia, Millet. Homostoma, Bellardi.) Fusiform or turriculated; columellar lip without callosity except a small posterior tooth. No operculum. The cancellated surface, more ventricose form and more evident canal distinguish it from Mangelia, the emargination of the outer lip from Clavatula,

the texture and sculpture of the surface from *Bela* and *Daphnella*. *P. linearis*, Blainv. (lviii, 26).

ZAFRA, A. Adams. Acuminately oval, tumid in the middle; whorls longitudinally plicate, the last constricted at the base; aperture linear; inner lip effuse, its margin free; outer lip acute, subsinuate behind, subinflected in the middle. *P. Pupoidea*, H. Ad. (lviii, 28).

DAPHNELLA, Hinds. Shell fusiform, thin, fragile, usually striated; aperture elongated oval, canal very short. Small and elegant shells of slight thickness, distinguished from *Defrancia* by their elongated body-whorl, tenuity and sculpture. No operculum. *P. ornata*, Hinds (lviii, 29).

MITROMORPHA, A. Ad. Shell small, elongately fusiform; whorls flattened, with revolving liræ, and sometimes longitudinally plicate. Aperture narrow; columella straight, slightly transversely lirate; lip acute, smooth within, scarcely sinuated posteriorly. It is a Mitriform *Daphnella*, of small size, with lirate whorls. *Distr.*—California, Japan. *M. gracilis*, Carp. (lviii, 30).

CITHARA, Schum. (*Mangelia*, Reeve [not Leach]. *Otocheilus*, Conr. *Cytharella*, Monts.) Fusiform, polished, longitudinally ribbed; aperture linear, truncated in front, slightly notched behind; outer lip margined, denticulated within; inner lip frequently finely striated. The animal has the mantle-margin slightly dilated on the right side. No operculum. Over 50 species occur at the Philippine Islands. *P. Stromboides*, Reeve (lviii, 31).

CYTHAROPSIS, A. Ad. Differs from *Cithara* in having a sub-produced recurved canal and cancellated surface. *C. cancellata*, A. Ad. Japan.

GLYPHOSTOMA, Gabb. Like *Cithara*, having numerous columellar plaits in adult specimens, but with a lengthened canal and deep narrow posterior lip-sinus. *P. dentifera*, Gabb (lviii, 32). A number of recent exotic species have been referred to this group.

MANGELIA, Leach. (*Bellaspira*, Conr.) Fusiform, mostly longitudinally ribbed; spire elongated, turriculated, acuminate; canal short, more or less truncated; columella smooth; sinus near the suture. No operculum. *P. ponderosa*, Reeve (lviii, 33).

TYPHLOMANGELIA, M. Sars. Narrow and elongate, spire produced conic, whorls many, nodosely angulate in the middle, aperture narrow, with distinct sinus, the outer lip simple, arcuate and inflexed in the middle. Operculum pyriform. Animal without eyes. *P. nivalis*, Lov. (lviii, 34).

SPIROTROPIS, Sars. Shell elongated, turreted, spire produced, the obtuse apex mammilliform, whorls numerous, carinated in the middle, aperture narrow, oblique, with a short canal, sinus deep,

remote from the suture. Operculum ovate-pyriform. *P. carinata*, Phil. (lviii, 35).

RAPHITOMA, Bellardi. Fusiform, turriculated, spirally sculptured; canal short; sinus very small. 22 sp. occur on the Dalmatian coast alone, but the cancellated species may be more properly referred to Clathurella. There are a number of Italian tertiary species. *P. ringens*, Bellardi (lviii, 36).

TARANIS, Jeffreys. Shell minute, cancellated, whorls angulated, slightly exserted at base, aperture pyriform, outer lip thin, simple, sinus obsolete, canal short. No operculum. *T. Mörchii*, Malm. (lviii, 37).

THESBIA, Jeffreys. Shell thin, rather smooth, somewhat tumid, with a short spire and irregularly contorted apex, aperture slightly expanded, the outer lip thin, with distinct sinus, canal short, columella simple. No operculum. *T. nana*, Lovén (lviii, 38).

PLEUROTOMELLA, Verrill. Shell somewhat turreted, apical whorls smooth, others shouldered and ribbed, but with a smooth concave band below the sutures; outer lip very thin, sharp, with a wide, deep sinus above. No operculum. Animal without eyes. *P. Packardii*, Verrill. N. Engl. Coast.

BORSONIA, Bellardi. (Oligotoma, Bell.) Shell fusiform, with a plication upon the middle of the columella. Miocene; Europe. *P. prima*, Bellardi (lviii, 39).

CORDIERA, Roualt. (Scobinella, Conr. Aphanitoma, Bellardi.) Shell fusiform, with two columellar plaits. This and the last subgenus should probably be merged in one. Eocene, Miocene; Eur., America. *P. Pyrenaica*, Roualt. (lviii, 40).

HALIA, Risso.

Etym.—*Halios*, marine. *Syn.*—Priamus, Beck.

Distr.—*H. Priamus*, Lam. (lviii, 41). Spain.

Shell oblong-ovate, ventricose, thin, polished; spire produced, apex obtuse, papillary; columella curved, truncate anteriorly; outer lip simple, thin, effuse, slightly sinuated near the fore-part. No operculum. A single species occurs very rarely in collections, and was supposed to inhabit the Western Coast of Spain; it occurs in the Italian tertiary. Dr. P. Fischer has examined the animal of this singular shell, and finds it to be related to Pleurotoma. Known to science for more than a century, the habitat of Halia has remained unknown until quite recently; it is now certain that it lives off Cadiz, Spain.

FAMILY CONIDÆ.

Teeth subulate, in two series, on a tubular prolongation of the retractile proboscis, with a bundle of sharp, subulate teeth at the extremity. Head with a produced tubular veil; tentacles subulate, eyes on bulgings or slight truncatures on the outer side of

the tentacles. Mantle enclosed, with an elongate siphon at the fore-part. Foot simple, undivided, oblong, with a conspicuous aquiferous pore on the middle of the under surface.

Operculum, when present, rather small, ovate or unguiform, with apical nucleus.

The great family of Cones, characterized by the peculiar structure of the mouth, no less than by the similarity in the form of the shell, are principally inhabitants of the equatorial seas. Haunting the holes and fissures of rocks, and the labyrinths of coral-reefs, they lead a predatory life, boring into the shells of other mollusks and sucking the juices from their bodies. In the Asiatic region the species seem greatly to predominate, whilst but two or three inhabit European seas, and about fifty the tropical shores of America. Low-water to 30 or 40 fathoms.

The teeth of *Conus* (x, 5) serve for attack or defense. Mr. Arthur Adams (*Voy. Samarang*, ii, 356) relates that, at the Moluccas, Sir Edward Belcher was bitten by a Cone, which suddenly exerted its proboscis as he took it out of the water with his hand, and he compares the sensation he experienced to that produced by the burning of phosphorus under the skin. The bite leaves a small, deep, triangular mark, which is succeeded by a watery vesicle.

CONUS, Linn.

Distr.—About 300 recent sp., and nearly 100 fossil forms. Cretaceous—. *C. marmoreus*, Linn. (lviii, 42).

Shell thick, obconic, whorls enrolled upon themselves, the spire short, or not elevated, smooth or tuberculated; aperture elongated, narrow, the margins parallel, truncated at the base; the outer lip with a slight sutural sinus. The typical group is limited by H. and A. Adams to species with regularly conic shell, short or depressed spire and coronated whorls.

STEPHANOCONUS, Mörch. Spire elevated, sutures concave. *C. cedonulli*, Linn. (lix, 44).

PUNCTICULIS, Swains. Spire slightly elevated, coronated, last whorl ventricose. *C. pulicarius*, Brug. (lviii, 43).

CORONAXIS, Swains. Shell a little turbinated, spire elevated, convex, coronated. *C. vermiculatus*, Lam. (lviii, 45).

CYLINDRELLA, Swains. Cylindrically conic, with revolving striæ; spire elevated, concave. *C. sulcatus*, Brug. (lviii, 46).

NUBECULA, Klein. (*Tuliparia*, Swains.) Shell light, subcylindrical; spire short, but pointed at the summit, whorls slightly coronated; aperture effuse, emarginate in front, columella smooth; outer lip with a wide but not deep notch at the suture. M. Quoy observes of this group that the foot is very large, and not entirely retractile within the shell, as in other members of the family; the anterior marginal groove conceals a large pore, the aperture of an aquiferous canal; the tubular veil is

fringed at the margin, and can sufficiently dilate itself to admit the tip of the little finger into the orifice. Operculum small, unguiculate, slightly curved. *C. tulipa*, Linn. (lviii, 47).

DENDROCONUS, Swains. Shell thick, convex-conic; spire truncated, not coronated. *C. figulinus*, Linn. (lix, 51).

LITHOCONUS, Mörch. Conical, carinated at the suture. *C. literatus*, Linn. (lix, 52).

LEPTOCONUS, Swains. Conical, sometimes striated; spire elevated, sharp, concave. The foot of *C. miles*, says Quoy, is very narrow, and the operculum longer than usual; the tentacles are slender and the veil pointed at the extremity. *C. nobilis*, Linn. (lix, 53).

RHIZOCONUS, Mörch. Shell conical, smooth; spire short but sharp, last whorl carinated at the suture. *C. generalis*, Linn. (lix, 54).

CHELYCONUS, Mörch. Spire elevated, last whorl convex near the suture. *C. spectrum*, Linn. (lviii, 48).

CYLINDER, Montf. (Textilia, Swains.) Shell conic-cylindrical, smooth; spire elevated, sharp; last whorl slightly ventricose. *C. textile*, Linn. (lviii, 49).

HERMES, Montf. (Theliconus, Swain.) Subcylindrical, with revolving ribs; spire elevated, obtuse, convex. *C. tendineus*, Brug. lix, 55).

CONORBIS, Swains. Spire much elevated; outer lip sinuous, forming an oblique posterior sinus. Connects Conus with Pleurotoma. Eocene; England, France. *C. dormitor*, Sol. (lviii, 50).

The above divisions are partly recognized as genera, partly as subgenera, by H. and A. Adams; but they possess little value, as their characters merge one into another. Weinkauff, who has recently monographed the genus, casts aside these divisions, and in their stead proposes sections, named after certain specific types, as follows:

1. Marmorei. (Typical Conus.) *C. marmoreus*, Linn.
2. Literati. (Lithoconus in part.) *C. literatus*, Linn.
3. Figulini. (Dendroconus.) *C. figulinus*, Linn.
4. Arenati. (Puncticulus.) *C. arenatus*, Hwass.
5. Mures. (Coronaxis.) *C. mus*, Hwass.
6. Varii. *C. varius*, Linn.
7. Ammirales. (Leptoconus and Rhizoconus in part.) *C. ammiralis*, Linn.
8. Capitanei. (Rhizoconus in part.) *C. capitaneus*, Linn.
9. Virgines. (Lithoconus in part.) *C. virgo*, Linn.
10. Dauci. (Rhizoconus in part.) *C. daucus*, Hwass.
11. Magi. (Phasmoconus and Pianoconus, Mörch.) *C. magus*, Linn.
12. Achatini. (Chelyconus.) *C. achatinus*, Chemn.

13. Asperi. (Hermes and Cylinder in part.) *C. asper*, Lam.
14. Terebri. (Hermes.) *C. terebra*, Born.
15. Bulbi. *C. bulbosus*, Reeve.
16. Tulipæ. (Nubecula, and Phasmoconus in part.) *C. tulipa*, Linn.
17. Texti. (Cylinder.) *C. textile*, Linn.

FAMILY STROMBIDÆ.

Shell with an expanded lip, deeply notched near the canal. Operculum claw-shaped, serrated on the outer edge.

Animal furnished with large eyes, placed on thick pedicels; tentacles slender, rising from the middle of the eye-pedicels. Foot narrow, ill-adapted for creeping. Lingual teeth single; uncini, three on each side (xi, 28).

Strombus gigas (lix, 56) is occasionally used as an article of diet; it sometimes produces pearls; and the layers composing the shell being of different colors, it is extensively used in carving cameos. It is also ground to powder for the manufacture of the finer kinds of porcelain, 300,000 having been imported into Liverpool from the Bahamas Islands in one year, and used chiefly for this purpose.

The perfect development of the large, fine, pedunculated eyes of *Strombus*, together with its very elongated, powerful, muscular body and foot, and claw-shaped, stout, jagged, horny operculum, constitute it one of the most active and intelligent of mollusks. It is, in fact, a most sprightly and energetic animal, making extraordinary leaps in its endeavors to escape from confinement, planting firmly its powerful narrow operculum against any resisting surface, insinuating it under the edge of its shell, and, by a vigorous effort, throwing itself forwards, carrying its great heavy shell with it, and rolling along in a series of jumps in a most singular and grotesque manner.—A. ADAMS, *Voy. Samarang*, ii, 493.

STROMBUS, Linn.

Etym.—*Strombos*, a top. *Syn.*—*Pyramis*, Bolt.

Distr.—66 sp. W. Indies, Medit., Red Sea, Ind. O., China, N. Zeal., Polynesia, W. tropical Am. Occurring on reefs, at low-water, and to 10 fms. Fossil, a few species. Cretaceous.—*S. gigas*, Linn. (lix, 56, 57).

Shell ovate, turreted or subfusiform; aperture narrow, elongate, emarginate or with a short canal in front, canaliculated posteriorly; outer lip often lobed and with a deep notch in front near the canal. In the young the lip is not expanded, and the shell looks like a *Conus*.

MONODACTYLUS (Klein). H. and A. Adams. Outer lip with a posterior much produced lobe. *S. Pacificus*, Swains. (lix, 58).

GALLINULA (Klein), H. and A. Adams. Inner lip not spread widely over the body-whorl; outer lip somewhat restricted; having a long posterior canal, ascending the spire. *S. succinctus*, Linn. (lix, 59).

CANARIUM, Schum., 1817. (Strombidea, Swains.) Inner lip restricted, outer lip not dilated, posterior canal short or obsolete. *S. Luhuanus*, Linn. (lix, 60).

EUPROTOMUS, Gill. Lip widely expanded, ascending the spire to its apex, the margins subdigitate, sinus of lip anterior. Most nearly related to Pterocera, among the Strombs. *S. laciniatus*, Chemn. (lix, 61).

ONCOMA, Mayer, 1876. Spire short; whorls convex, keeled or tuberculate; the last very large, keeled behind; mouth long, with short anterior canal; outer lip wing-like, entire. 8 sp. Eocene and Oligocene. *S. Fortisi*, Brongt.

PTERODONTA, d'Orbigny.

Distr.—Fossil, 8 sp. Chalk; France. *P. inflata*, d'Orbigny (lxxxviii, 56).

Shell oblong, ventricose, spire elongated; aperture oval, lip slightly expanded, notched in front, and with a tooth-like ridge internally, remote from the margin.

PUGNELLUS, Conr.

Distr.—Fossil. Cretaceous only. *P. hamulus*, Gabb (lx, 71, 72).

Shell fusiform in the young state; in the adult aperture narrow, outer lip developed into a massive lobe, notched above and below; canal produced and incurved; the whole shell enveloped in a more or less heavy incrustation, a prolongation of the deposit on the inner lip.

GYMNARUS, Gabb. Outer lip less heavy and produced posteriorly in a hook; anterior canal slightly produced and straight; incrustation not covering the entire shell, the back being exposed. A single species from the Chico group (Cret.) of California. *P. manubriatus*, Gabb (lx, 73).

PTEROCERA, Lam.

Etym.—*Pteron*, a wing, and *ceras*, a horn.

Syn.—Harpago, Millipes and Heptadactylus, Klein.

Distr.—10 recent sp. Indian Ocean and eastern Pacific. Fossil. Jurassic, Cret.—*P. lambis*, Linn. (lix, 62).

Outer edge of mantle digitate. Operculum as in Strombus. Shell ovate, spire more or less elevated; aperture elongate, outer lip digitate, with a long, straight or curved anterior canal, and a shorter or long posterior canal, ascending and surpassing the spire.

When young, the outer lip of the shell is simple, resembling that of *Strombus*; the claws are gradually formed with the growth of the shell and are at first open canals, which afterwards become closed and solid.

Messrs. Adams adopted two of Klein's names for subgenera having no good characters; these may be advantageously replaced by Prof. Theo. Gill's arrangement, as follows:

PTEROCERA, Lam. (restricted). Anterior canal straight or curved to the right, posterior canal ascending the spire.

HARPAGO (Klein), H. and A. Adams. Anterior and posterior canals both curved to the left, the latter at first crossing transversely to the length of the shell. *P. rugosa*, Sowb. (lix, 63).

PHYLLOCHEILUS, Gabb, 1868. (Malaptera, Piette, 1879.) Outer lip with no digitations, or small ones only; inner lip expanded as a thin plate over the front of the body-whorl, and sometimes projecting beyond it laterally; both outer and inner lips deeply notched anteriorly, near the canal. *P. speciosa*, d'Orb. (lx, 74).

ROSTELLARIA, Lam.

Etym.—*Rostellum*, a little beak.

Syn.—*Fusus*, Humphr. *Gladius*, Klein. *Platyoptera*, Conr. *Rostellum*, Montf.

Distr.—8 sp. Red Sea, India, Borneo, China. Range, 30 fms. *R. curta*, Sowb. (lix, 64).

Animal with digitated mantle-margin. Operculum not serrated. Shell fusiform with elevated spire, whorls smooth; aperture continued into a long, straight or slightly curved anterior canal; outer lip slightly thickened on the margin and denticulated. The (restricted) *Rostellarias* belong to the present epoch, or extend at most only into the more recent tertiaries.

HIPPOCHRENES, Montf. Posterior canal extending up the spire to near the apex, or curving behind it; lip much expanded. An Eocene group; Europe and America. *R. macroptera*, Lam. (lx, 75).

RIMELLA, Agassiz. Whorls cancellated, posterior canal running up the spire, anterior canal short. Cretaceous—recent. *R. crispata*, Sowb. (lix, 65).

LEIORHINUS, Gabb. Fusiform, spire about as long as the aperture; columella slightly twisted and with a fold or thickening on the edge, extending to the end of the canal; inner lip thickened and with one tooth near the suture; outer lip thickened posterior to the edge; edge thin and incurved, with a small emargination posteriorly, and opposite to the tooth on the inner lip; no anterior sinus; surface smooth or only marked by lines of growth. *P. proruta*, Conrad (lx, 92). Eocene; Ala. Gabb placed it in *Pleurotomidæ*, but it was subsequently referred here by Conrad and Meek.

ISOPLEURA, Meek. Longitudinally ribbed, aperture narrow, notched in front, outer lip simple, no posterior canal. Cretaceous. *R. curvilirata*, Conr. (lx, 76).

CYCLOMOLOPS, Gabb. Smooth, without anterior canal, posterior canal long, running up the spire, columellar lip with a thick callus which, continuing around the anterior end of the aperture, forms a thickened margin to the outer lip. *R. lævigata*, Melv. (lx, 77).

ORTHAULAX, Gabb. Shell rounded-fusiform, canal moderate, straight and regularly tapering; adult shell enveloped over the whole spire by an extension of the inner-lip callus; posterior canal fissure-like, formed by the continued edge of the outer lip and running directly to the apex; outer lip apparently sharp and simple, anterior notch oblique and broad. *P. inornata*, Gabb. Tertiary; West Indies.

CALYPTRAPHORUS, Conr. Anterior canal long and straight; posterior canal long, appressed to the spire and arching on the back; outer lip moderate, rounded and thickened on the margin by a smooth border; young shell showing all the volutions, which are hidden in the adult by a polished incrustation covering the entire surface, and in some species bearing tubercles. Eocene; U. S. Cretaceous; India. *R. trinodiferus*, Conr. (lx, 78).

SPINIGERA, d'Orb.

Distr.—5 sp. Fossil, in the Oolite of Europe. *S. longispina*, Desl. (lx, 79). *S. spinosa*, Munst. (lx, 80).

Shell elongated, slender, fusiform, with a long, straight anterior canal; each volution bearing one or two varices, those of successive whorls being arranged continuously as in *Ranella*, and bearing each a long, transverse spine.

TEREBELLUM, Lam.

Etym.—Diminutive of *terebra*, an auger.

Syn.—Seraphs, Montf.

Distr.—*T. subulatum*, Lam. (lix, 66). China, Philippines. Fossil, 8 sp. Eocene—; London, Paris.

Animal with eyes on the ends of peduncles, no tentacles, foot anteriorly small and rudimentary. Operculum narrow, denticulate. Shell subulate, spire slightly produced or blunt; aperture narrow, notched in front; outer lip simple, sharp; inner lip more or less incrustated, the columella straight and truncate.

The *Terebellum* inhabits deep water. In progressing, it rolls its shell over and over, performing a series of irregular jumps; when first taken from the water, it will even leap several inches from the ground. It is extremely shy and sensitive in its habits, poising the shell in a vertical position, and protruding the longer telescope eye (for, singularly enough, one eye-pedicle

is longer than the other) from the notch in front of the shell; it will thus remain perfectly immovable until assured of security, when it begins to roll over and examine the ground with its rostrum.

TEREBELLOPSIS, Leymerie. Spire very long. A single French nummulitic fossil. *T. Braunii*, Leym. (lx, 81).

APORRHAI, Dillw.

Etym.—Spout-shell, from *aporrheo*, to flow away.

Syn.—Chenopus, Phil.

Distr.—4 recent sp. W. Africa, Mediterranean, boreal Europe and America. Range, 100 fathoms. Fossil. Lias—. *A. pes-pelecani*, Lam. (lix, 67).

Animal with elongated, tapering muzzle; tentacles subulate, with eyes at their outer bases; mantle with outer side expanded, lobed, and with a rudimentary siphon in front, bending to the right; foot small, oblong, simple. Operculum lamellar, ovate or pointed, nucleus small, apical.

Shell fusiform, turreted or oblong-ovate, with a short canal in front and a posterior canal running up the spire; outer lip of the adult expanded and 2-3 digitated, the digitations forming carinæ on the back of the shell. The rostriform head, sessile eyes and rudimentary siphon, together with certain peculiarities of the shell, have been supposed to indicate strong affinities with the Cerithiidae; but that these mollusks are most closely related to the Strombs (which they certainly resemble in dentition) is scarcely doubtful.

Chiropteron semilunare is probably a larval *Aporrhais*.

On the authority for the generic name, see Gabb, *Am. Jour. Conch.*, iv, 143.

GONIOCHEILA, Gabb. (*Alipes*, Conr.) Shell with posterior canal extending about half-way up the spire, and not free at the end; expanded outer lip with only one projecting angular process, but bearing one or more external carinæ in front of this that do not terminate in marginal digitations; canal short and strongly incurved; inner lip thick. *A. tiratus*, Conr. (lx, 82).

ARRHOGES, Gabb. (*Monocuphus*, Piette. Perissoptera, in part, Tate.) Shell with expanded lip, merely terminating in a single posterior obtuse lobe-like extension, and having its anterior sinus nearly or quite obsolete; posterior canal *very* short; anterior canal also short and obtuse. *Rostellaria occidentalis*, Beck (lix, 68; the only species (recent).

CYPHOSOLENUS, Piette, 1876. Shell turreted, fusiform, with longitudinal ribs and numerous revolving riblets; last whorl with a pair of tuberculate carinæ, forming two digitations; wing subpalmate, tridactylous, not sinuous, the digitations long;

canal produced anteriorly into a long digitation. *C. tetracer*, d'Orb. Several species. Jurassic; France.

ANCHURA, Conr.

Syn.—Drepanocheilus, Meek. Perissoptera, Tate. Monodactyles, Piette.

Distr.—Jur., Cret.; America. Species numerous. *A. abrupta*, Conr. (lx, 83). *A. falciformis*, Gabb (lx, 84).

Fusiform, anterior canal straight, more or less produced; no posterior canal; outer lip produced postero-laterally into a lobe or process, which is scythe-shaped, or falcate.

The original *Anchura* had a falcate process, whilst that of Meek's subgenus is single to the end and scythe-shaped, but a series of species show every gradation between the two.

HELICAULAX, Gabb, 1868.

Distr.—Cret.; Europe. *H. ornata*, d'Orb. (lx, 85).

Shell like *Anchura*, but with a long posterior canal ascending the spire to near the apex, usually deflected near its extremity; inner lip usually heavily incrustated, the callus sometimes extending some distance up the spire.

DIMORPHOSOMA, Gardner, 1875. Like *Helicaulax*, but posterior canal short; a single small, sickle-form wing, only attached to the last or last two whorls. *H. calcarata*, Sowb.

LISPODESTHES, White, 1875.

Distr.—2 sp. Cretaceous; N. America. *L. linguifera*, White (lx, 86).

Shell fusiform; anterior canal straight or slightly curved, and more or less produced; posterior canal extending nearly or quite the whole length of the spire, from near the apex of which it may be a little deflected; aperture winged; wing rather large, bearing two processes; the posterior process spine-like or falciform; the anterior process either in the form of a lobe or tongue-shaped; inner lip and spire covered with callus.

Related to *Helicaulax*, Gabb, of which it may be only a subgenus.

PEREIRÆA, Crosse.

Distr.—*P. Gervaisii*, Vezian (lx, 87). Tertiary of Portugal.

Whorls all coronated with spiny tubercles except the last, where they are replaced by a carina. Lip prolonged in front, thick, with two digitations. Columella and ventral portion of the shell covered with enamel.

DICROLOMA, Gabb.

Syn.—Hemicaudes, Piette. Tridactylus, Gardner.

Distr.—Lias and Oolite; Europe. *D. Lorieri*, d'Orb. (lx, 88).

Elongate, fusiform, anterior canal long and straight, or curved; no posterior canal; outer lip with two long, slender, digitate processes.

TESSAROLAX, Gabb.

Distr.—Cret.; Am., Eur. *T. bicarinata*, d'Orb. (lx, 89).

Shell subfusiform, spire elevated; the greater part or whole of spire and body-whorl covered by an extension of the inner lip in the adult; anterior canal long, curved or straight; posterior canal long, running up the spire and extending beyond it; outer lip carrying two long, slender digitate processes; the incrustation of the adult shells carries one or two prominent bosses or tubercles on the body-whorl.

PTEROCERELLA, Meek. Shell small, thin; whorls few, rounded, smooth or subangulated; last one not much enlarged. Lip greatly extended, and ascending the spire, trilobate—the middle lobe much larger and more produced than the others, carinated on the outer side. *T. Tippiana*, Conrad (lx, 90). Cretaceous.

ALARIA, Morris and Lycett, 1850.

Syn.—Alaria, sections Varicifer and Longicaudes, Piette.

Distr.—Jurassic; Eur., India. *A. armata*, Morris and Lycett (lx, 91).

Shell fusiform, spire elevated; anterior canal more or less produced, straight or curved; no posterior canal; outer lip digitate, formed at one or more stages previous to the adult age, and left behind by the growth of the shell, producing varices or tubular spines; inner lip thin.

The above description defines the genus as restricted by Gabb.

DIARTHEMA, Piette. Shell with continuous varices; a wing-like varix opposite the mouth. Lower Oolite; France. *A. paradoxa*, Desh.

CUPHOTIPHER, Piette. The wing-like varix with a strong, laterally compressed tubercle, sometimes developing a posterior finger. *D. ranelloides*, Piette. Jura.

DIEMPTERUS, Piette, 1876. Shell fusiform, winged, with straight anterior canal; whorls with spines or varices; wing entire or digitate; last whorl with a strong varix opposite the wing, indicating the position of a former mouth. *D. goniata*, Heb. Callovien.

HARPAGODES, Gill, 1869.

Distr.—Cret. and Jur.; Europe. *H. pelagi*, d'Orb. (lx, 93).

Shell obconic or ovate-conoid, spire moderate, canal produced into a long digitation boldly recurved towards the left, labrum much alated and produced into spiniform digitations. Whorls convex or flat between the angle and suture, spirally ribbed, with larger rib-like, angular, median, and anterior fascioles (and sometimes post-angular), each emitting long spiniform digitations;

and with a sutural canaliculate digitation accumbent on the spire, continued and recurved backwards.

CERATOSIPHON, Gill, 1870.

Syn.—Ornithopus (in part), Gardner, 1875.

Distr.—Cret.; France. *C. Moreausiana*, d'Orb. (lx, 94).

Shell fusiconic, with the spire considerably elevated, the canal produced into a long digitation recurved towards the left, and the labrum much alated and produced into spiniform digitations. Whorls concave or flat between the angle and suture, spirally striated, and with rib-like angular, median and anterior fascioles, of which the two former, at least, emit spiniform digitations, the suture emitting a digitiform canal accumbent on the spire and directed backwards.

Distinguished by the elongated hamiform siphonal canal and the posterior canal co-ordinated with the *facies* of Aporrhais.

STRUTHIOLARIA, Lam.

Etym.—*Struthio*, an ostrich (-foot), from the form of the aperture.

Distr.—5 sp. Australia, New Zealand. *S. nodulosa*, Mart. (lix, 69). Fossil. Tertiary; N. Zeal., So. Ama.

Animal with outer mantle-margin simple, tentacles cylindrical, eye-pedicels short, adnate with the tentacles externally, foot broad and short. Operculum claw-shaped, with an apical projection. Shell turreted, whorls angular, aperture truncated in front, columella very oblique; outer lip prominent in the middle, reflected and thickened in the adult, inner lip callous, expanded.

PELICARIA, Gray. Shell elevated, turreted; spire of adult covered with enamel; aperture ovate; outer lip sinuous, thin, inner lip incrustated. A single species, *S. scutulata*, Mart. (lix, 70).

LOXOTREMA, Gabb. Shell elongate, turreted, spire high; aperture with a very short canal in front; outer lip retreating above, sinuous below; inner lip heavily incrustated. *S. turrita*, Gabb (lx, 95).

DOLOPHANES, Gabb. Elongate-oval, spire elevated; umbilicus imperforate; aperture semi-oval, inner lip acute, sinuous, anteriorly terminating in a short, not emarginate canal. *S. melanoides*, Gabb. Tertiary; West Indies.

FAMILY CYPRÆIDÆ.

Shell convolute, enameled; spire concealed by the last whorl, which is very large; aperture narrow, channeled at each end; outer lip (of adult) thickened, inflected. No operculum.

Animal with a broad foot, truncated in front; mantle expanded on each side, forming lobes, which meet over the back of the shell; these lobes are usually ornamented with tentacular fila-

ments; eyes on the middle of the tentacles or near their base; branchial plume single. Lingual ribbon long; rachis 1-toothed; uncinii 3 (xi, 30).

CYPRÆA, Linn.

Cowry. *Etym.*—*Cypris*, a name of Venus.

Syn.—*Porcellana*, Rumph. *Naria*, Gray. *Cypræorbis* and *Sulcocypræa*, Conr. *Peribolus*, Adans.

Distr.—200 sp. Tropical and subtropical, on reefs and under rocks at low-water. Fossil, 100 sp. Cretaceous—; Europe, India, United States. *C. argus*, Linn. (lxi, 96). *C. exanthema*, Linn., young (lxi, 97).

Shell ventricose, convolute, covered with shining enamel; spire concealed; aperture long and narrow, with a short canal at each end; inner lip crenulated; outer lip inflected and crenulated.

The young shell has a thin and sharp outer lip, a prominent spire, and is covered with a thin epidermis. When full-grown the mantle-lobes expand on each side, and deposit a shining enamel over the whole shell, by which the spire is entirely concealed. There is usually a line of paler color, which indicates where the mantle-lobes met. *Cypræa annulus* is used by the Asiatic Islanders to adorn their dress, to weight their fishing-nets, and for barter. Specimens of it were found by Dr. Layard in the ruins of Nimroud. The money-cowry (*C. moneta*, lxi, 1) is also a native of the Pacific and Eastern seas; many tons weight of this little shell are annually imported into England, and again exported for barter with the native tribes of Western Africa; in the year 1848 sixty tons of the money-cowry were imported into Liverpool. Mr. Adams observed the pteropodous fry of *C. annulus*, at Singapore, adhering in masses to the mantle of the parent, or swimming in rapid gyrations, or with abrupt jerking movements by means of their cephalic fins.

Bruguiere stated, and Lamarck believed, that as the animal increased in size, it was obliged to leave its shell, in order to make a new and more capacious one. The notion of Sowerby and Reeve that *Cypræa* can absorb the outer lip and form another is not less fanciful. Such hypotheses were founded on the circumstance that full-grown shells are often smaller than half-grown specimens; but the difference of size in individuals of the present family is paralleled in many others.

In their habits the cowries are shy and crawl slowly; as they glide along among the coral reefs, with the lateral lobes of their mantle adorned with showy colors, they present to the eye of the naturalist objects of singular interest and beauty.

LUPONIA, Gray. (*Cypræidia*, Swains.) Comprises the pyriform species, having usually a few strong irregular plaits at the fore-

part of the columella. *C. lynx*, Linn. (lxi, 98). *C. tigris*, Linn. (lxi, 99).

ARICIA, Gray. Characterized by the flattened base and thickened callous margins of the last whorl, and gibbous back. *C. Arabica*, Linn. (lxi, 100). *C. moneta*, Linn. (lxi, 1).

CYPRÆOVULA, Gray. Pyriform, oval, ventricose; surface covered with revolving striæ. 2 sp. Cape of Good Hope. *C. Capensis*, Gray (lxi, 4, 5).

GASKOINIA, Roberts. (Pseudocassis, Pictet.) Form of Luponia, aperture without teeth. One recent species; and a cast. Creteceous; Europe. *C. edentula*, Sowb. (lxi, 2, 3).

Troschel adopts the genera Cypræa and Aricia, and proposes the following subgeneric groups, which have not been adopted because the species cited as typical may be mostly connected by other species having intermediate characters.

Cypræa—

- Subgenus Talparia. *C. talpa*, Linn.
- “ Tigris. *C. tigris*, Linn.
- “ Lyncina. *C. lynx*, Linn.
- “ Mauritia. *C. Mauritiana*, Linn.

Aricia—

- Subgenus Erronea. *C. erronea*, Linn.
- “ Erosaria. *C. erosa*, Linn.
- “ Monetaria. *C. moneta*, Linn.

TRIVIA, Gray. (Coccinella, Leach.) Small shells with striæ extending over the back, where they are frequently interrupted by an impressed dorsal sulcus. 45 species, one of which inhabits the temperate seas of Northern Europe. *C. quadripunctata*, Gray (lxi, 6, 7). “It is surprising to see with what facility the expanded animal of Trivia withdraws itself—foot, mantle, head and tube—through the narrow opening of the shell (Clark’s MS.). Like *Buccinum undatum* it continually discharges an immense quantity of clear slime. Couch says that it often gets into crab-pots; so that it seems to be fond of all kinds of animal food.”—JEFFREYS.

PUSTULARIA, Swainson. Back with rows of pustules proceeding from the dorsal sulcus, both lips ribbed clear across. *C. pustulata*, Lam. (lxi, 8, 9).

EPONA, H. and A. Adams. Globular, produced at the extremities; lips more less striated across. *C. cicercula*, Linn. (lxi, 10, 11).

[ERATO, Risso.

This group, which I have placed in Marginellidæ (p. 172), may belong here; it is somewhat closely related to Trivia, through its sculptured species, and (apparently) in dentition.]

OVULUM, Brug.

Syn.—Amphiperas, Gronov. Simnia, Risso.

Distr.—75 sp. Tropical and subtropical. Fossil. Tertiary—*O. pyriformis*, Sowb. (lxi, 12, 13).

Shell ventricose, convolute, attenuated and subacuminated at both ends; outer lip of adult thickened and inflected.

These shells are not ornamented with the rich and varied colors of the cowries, having but little pattern-painting; they are at once distinguished from them by the attenuated and frequently produced ends.

Simnia was proposed for a few species, with sharp aperture-margin, which have proved to be the young of typical Ovulæ.

CALPURNUS, Montf. (Cyprella, Swains.) Cyprellaform, gibbous, with a small tubercle at each extremity. *O. verrucosum*, Linn. (lxi, 14, 15).

CYPHOMA, Bolten. (Carinea, Swains.) Shell with a transverse dorsal rib; inner lip smooth, outer lip very slightly crenulated. *C. gibbosum*, Linn. (lxi, 16, 17).

VOLVA, Bolten. (Birostra, Swains. Radius, Montf.) Shell ventricose in the middle, both extremities prolonged into canals; lips both without teeth. Animal, mantle-margin with glandular tubercles, foot narrow, folded lengthwise on itself, adapted for creeping on the narrow, rounded branches of gorgoniæ and corals—on which it is supposed to feed. *C. volva*, Linn. (lxi, 18).

CRITHE, Gould. Shell ovate with produced extremities, and a delicate groove at the summit; aperture narrow, outer lip unarmed; base of the shell with about eight coarse laminae, passing into the aperture, and having the appearance of dentations on the inner lip. *O. atomaria*, Gld. China Seas.

PEDICULARIA, Swainson.

Syn.—Thyreus, Phil.

Distr.—9 recent sp. Europe, Polynesia. 1 Miocene sp. Eur. *P. Sicula*, Swains. (lxi, 19, 20).

Shell small, limpet-like, irregular, with small, short spire, concealed with the growth, and a radiately ribbed surface when young; mouth large, lips simple, irregular. Animal with eyes sessile at the outer bases of the tentacles, mantle enclosed, not produced into a siphon in front, foot small. Operculum none.

DENTIORA, Pease. Columella plane or excavated, compressed and dentate within. *D. rubida*, Pease. Sandwich Is.

FAMILY CASSIDIDÆ.

Shell solid, subglobular or triangular; spire short, whorls sometimes varicose; aperture terminating anteriorly in a shortly recurved canal, columella callous, usually plicated, outer lip ribbed, dentate within.

Animal with large head, and eyes at the exterior base of the tentacles, proboscis cylindrical, extensible, mantle and foot large. Operculum corneous, oval or oblong.

The Cassides are active and voracious, living in sandy localities and preying upon bivalve mollusks.

CASSIS, Lamarek.

Syn.—Cassidea, Brug. Goniogalea, Mörch. Galeodaria, Conr.

Distr.—37 sp Tropical; West Indies, Mediterranean, Africa, China, Japan, Australia. Fossil, 36 sp. Eocene—; Chili, France. *C. Madagascariensis*, Lam. (lxii, 22)

Shell solid, thick, with the last whorl very large, varicose; aperture longitudinal, narrow, outer lip with a thickened, reflected margin, and dentate within, inner lip rugosely plicate. Operculum oval, narrow, with median apex (lxii, 28).

These shells are well adapted for cameo-cutting, from their substance being made up of differently-colored layers, and also from a difference of hardness and texture in the various layers, some approaching more nearly to the nature of nacreous than of porcellaneous material.

The word *cameo*, derived from the Arab word, signifying bas-relief, was originally restricted to hard stones, such as onyx, sardonyx, etc., engraved in relief; but the name has since been extended to gems cut on shell, lava, and other substances.

In cameos the central layer forms the body of the relief, the inner layer being the ground, and the outer the third or superficial color, which is sometimes used to give a varied appearance to the surface of the figure.

Shell-cameos, some years ago, were a good deal in fashion; and even now a well-executed, artistic Roman shell-cameo is an elegant piece of art. Genoa and Rome are the seats of the best work, although many common ones are cut in France. In Rome there are about eighty shell-cameo cutters, and in Genoa thirty, some of whom also carve in coral. The art of cameo-cutting was confined to Rome for upward of forty years, and to Italy until the last twenty-six years, at which time an Italian began cutting cameos in Paris, and now over 3000 persons are employed in that city.

The black helmet (*Cassis Madagascariensis*), on account of the advantageous contrast of colors in the layers, produces very effective cameos, the carved figure of the white upper layer being strongly relieved by the dark, almost black, ground supplied by the second layer.

The shell is first cut into pieces the size of the required cameos, by means of diamond dust and the slitting mill, or by a blade of steel fed with emery and water. It is then carefully shaped into a square, oval or other form on the grindstone, and

the edge finished with oil-stone. It is next cemented to a block of wood, which serves as a handle to be grasped by the artist while tracing out with a pencil the figure to be cut on the shell.

The pencil-mark is followed by a sharp point, which scratches the desired outline, and this again by delicate tools of steel wire, flattened at the end and hardened, and by files and gravers, for the removal of the superfluous portions of the white enamel. A common darning-needle, fixed in a wooden handle, forms a useful tool in this very minute and delicate species of carving. The careful manipulation necessary in this work can only be acquired by experience; the general shape must first be wrought, care being taken to leave every projection rather in excess, to be gradually reduced as the details and finish of the work are approached. To render the high parts more distinct during the process of carving they are slightly marked in black.—SIMMONDS, *Commercial Products of the Sea*, 272.

SEMICASSIS, Klein. (Cassidea, Swm.) Shell oval, with revolving ribs, spire moderate, sharp. *C. canaliculatus*, Brug. (lxii, 23).

PHALIMUM, Link. (Bezoardica, Schum., 1817.) Shell varicose, angular behind, oval, with moderate spire; outer lip usually strongly dentated in front. *C. undatus*, Mart. (lxii, 24).

CASMARIA, H. and A. Adams. Shell smooth, whorls simple or subplicate, spire moderate; inner lip smooth, callous, outer lip margined, smooth or slightly crenulated on the inner edge. *C. pyrum*, Lam. (lxii, 25).

CASSIDEA, Link. (Cypræcassis, Stutchb.) Shell ovate, spire short; mouth narrow, subcanaliculate behind, columella plicate its entire length; varices none or obsolete. No operculum. The mantle-margins are reflected over the lips of the shell. *C. testiculus*, Linn. (lxii, 26).

LEVENIA, Gray. Shell oval, subcylindrical, spire short, conic; aperture narrow, contracted in the middle, columellar lip plicate throughout, outer lip without external rib, inflexed and dentate. Operculum narrow. *C. coarctatus*, Gray (lxii, 27).

CASSIDARIA, Lam.

Etym.—*Cassida*, a helmet.

Syn.—Galeodea, H. and A. Adams. Morio, Montf.

Distr.—5 sp. Mediterranean. Fossil, 30 sp. Cretaceous, Eocene—; Europe, West Indies. *C. echinophora*, Linn. (lxii, 29). Shell nodulous, ovate or oval-oblong, somewhat attenuated in front to a short, subascending canal; inner lip more or less spread over the body-whorl, tuberculated or plicate, outer lip reflected, ribbed and plicate within. Operculum corneous, ovate, summit median and marginal, outer edge sinuous.

SCONZIA, Gray. Shell oval-fusiform, with revolving striæ and a single longitudinal varix; aperture long, canal very short, and

slightly reflected; inner lip regularly plicate, the anterior plications the largest; outer lip rather thick, subreflected, plicate within. Animal and operculum unknown. A single recent species. *C. striata*, Lam. (lxii, 30). Also Tertiary and Cretaceous.

ONISCIA, Sowb.

Etym.—*Oniscus*, a wood-louse.

Syn.—*Morum*, Bolten. *Ersina*, Gray. *Lambidium*, Link.

Distr.—9 sp. West Indies, China, Galapagos. Fossil, 3 sp. Miocene; United States, St. Domingo. *O. oniscus*, Lam. (lxii, 31).

Shell subcylindrical, conoidal, with short spire, and canal reflected at the base, surface tuberculated, mouth linear, right lip reflected, thickened and plicate within, inner lip plicate.

These little shells are known by their transversely ribbed nodulous whorls, and prominent, recurved siphonal canal; when fresh the surface is covered with a fine velvety epidermis.

ONISCIDIA, Swains. Oval, tuberculate-cancellate, inner lip granulated. *O. cancellata*, Sowb. (lxii, 32).

PACHYBATRON, Gaskoin.

Distr.—3 sp. Tropical; West Indies, East Indies. *P. Marginelloideum*, Gask. (lxii, 33).

Shell small, subcylindrical, longitudinally striated; spire very short, but with sharp apex; aperture narrow, very long, the inner lip spread over the body-whorl and transversely plicate, the outer lip thickened and denticulated within.

FAMILY DOLIIDÆ.

Shell thin, with short spire and very large body-whorl, covered with revolving ribs.

Animal very large, with a wide head bearing two elongated, obtuse, distant tentacles, dilated at the base, where are situated the eyes, proboscis cylindrical, greatly developed, extensible and flexible, foot oval, very large, lobed and dilated in front, with a horizontal groove. No operculum in the adult. Dentition (xi, 32).

DOLIUM, Linn.

Tun-shell. *Syn.*—*Perdix*, Montf. *Doliopsis*, Conrad.

Distr.—15 sp. Mediterranean, West Indies, off Rhode Island, Ceylon, China, Philippines, Australia. Fossil, 8 sp. Cretaceous, Tertiary; So. Europe, United States. *D. perdix*, Linn. (lxii, 21, 34).

Shell thin, ventricose, inflated, subglobular, with revolving ribs; mouth very large, the outer lip crenulated, columella canaliculated. The genus *Macgillivraya* (xx, 44, 46; lxii, 36) is founded upon the larva of *Dolium*; it has four tentacles, and the foot is

provided with a float, like *Ianthina*; the larval shell has a thin, corneous operculum.

MALEA, Valenciennes.

Syn.—Cadium, H. and A. Adams.

Distr.—*M. ringens*, Swains. (lxii, 25). *M. denticulatum*, Desh. Pliocene.

Shell having the form and sculpture of *Dolium*, but the outer lip is thickened, somewhat reflected, and denticulated, inner lip with calloused plicate prominences.

PYRULA, Lam.

Fig-shell. *Etym.*—Diminutive of *pyrus*, a pear.

Syn.—*Ficus*, Rousseau. *Ficula*, Swainson. *Otus*, Risso. *Sycotypus* (Browne), Adams. *Ficopsis*, Conrad.

Distr.—8 sp. West Indies, Philippines, W. Tropical America. Fossil. Cret.; India. Cret. and Eocene; United States. *P. decussata*, Wood (lxii, 37). *P. ficus*, Linn. (lxii, 40).

Shell thin, pear-shaped, terminating anteriorly in a moderate canal; lip thin, smooth; surface cancellated or with revolving ribs.

Animal with subulate tentacles and eyes at their outer bases; mantle produced on each side, covering the shell; siphon straight, elongated; foot simple, thin, produced posteriorly. No operculum.

The *Pyrulæ* crawl very rapidly, bearing their light, elegantly-formed shells easily, and, with their neck stretched out, their siphon exerted, and their foot greatly expanded, present remarkable objects of contemplation to the malacozoologist. They are generally delicately flesh-tinted, with faint, marbled, crimson and pink markings; their eyes are large and black, and their long flat heads and necks usually white.

PTYCHOSYCA, Gabb. Shell shaped like *Pyrula*: inner lip with one anterior very oblique fold. *P. inornata*, Gabb (lxii, 39). Cretaceous; Georgia.

FICULOPSIS, Stoliczka. Pyriform, attenuated in front, inflated behind; spire very short; surface spirally and transversely striate or costulate; columella thick, angulated, plicate. *P. Pondicherriensis*, Forbes (lxii, 38). Cretaceous; So. India.

(*Macgillivrayidæ*?)

The two following genera are probably larval prosobranchiate mollusks.

ETHELLA, H. and A. Adams.

Distr.—*E. Macdonaldi*, Ad. (lxxxvii, 10, 11). Australia.

Ciliated arms six in number; creeping disk rudimentary;

operculigerous lobe long, cylindrical, bearing the operculum on its truncated extremity. Operculum claw-like, with a spiral nucleus situated near the internal or thickened border.

Shell spiral, turbinate, imperforate; spire elevated, whorls rounded; aperture oval, produced in front.

The little animal wields its clawed operculum, apparently as a weapon of defense, with great dexterity, and skips and jerks about by means of its complex foot.

GEMELLA, H. and A. Adams.

Distr.—*G. hyalina*, H. and A. Ad. (lxxxvii, 12). South Pacific.

The foot is not unlike a broad or square-toed shoe in form, receiving or bearing the remainder of the animal and the shell. The little animal creeps with great rapidity, and by hollowing the disk of its foot into a boat-form, like *Limnæa*, it floats upon the surface of the seas.

Operculum paucispiral, the lines of growth well-marked.

Shell subglobose, thin, pellucid, not umbilicated; spire small, compressed, whorls few, smooth; aperture large, entire.

FAMILY NATICIDÆ.

Shell globular or oval, spire usually short, aperture semilunar, without canal or anterior notch, the outer lip sharp, the columellar lip callous, more or less reflected over the umbilicus.

Animal with small tentacles, which are lanceolate, wide apart, united by a veil; eyes usually absent, or very minute and placed beneath the tentacular veil; mantle enclosed; foot much produced in front, where it is furnished with a fold which covers the head and tentacles; operculigerous lobe very ample, partially enveloping the shell. Operculum paucispiral, corneous, or with an exterior calcareous layer. Dentition, 3·1·3 (xi, 31).

The nidus of *Natica* (xvii, 95) is unlike that of any other mollusk in form and composition, being built up largely of the sand of the sea-bottom, formed into a partly circular form constricted into a neck above, the walls of which contain the eggs arranged in quincunx order.

NATICA, Lam.

Distr.—About 200 recent sp. World-wide, and ranging from low-water to 90 fathoms. Fossil, 500 sp. Silurian—; world-wide. *N. Alderi*, Forbes (lxiii, 41). *N. canrena*, Linn. (lxiii, 42).

Shell subglobular, spire slightly elevated, aperture half-round, a spiral columellar callus entering the umbilicus.

Animal blind, completely retractile within its shell. Operculum with an exterior calcareous layer.

The animals of *Natica* (typical) move quickly; they are carnivorous and very predaceous, living in sandy places, where

they hide under the surface and burrow after bivalves. Range, from low-water to 90 fathoms. The colored markings of the shells are very indestructible, being frequently preserved on fossils.

STIGMAULAX, Mörch. Whorls cancellated or sillonated; umbilicus with spiral funiculum. Operculum with calcareous outer layer. *N. cancellata*, Lam. (lxiii, 43).

LUNATIA, Gray. (Euspira, Agass., in part. Globularia, Swn.) Shell usually sombre-colored, covered with a dark, thin epidermis; not so thick as the typical group; umbilicus open, without funiculum. Operculum corneous. Inhabit usually cold or temperate rather than tropical seas. *N. heros*, Say (lxiii, 44).

NEVERITA, Risso. (Naticaria, H. and A. Adams.) Shell depressed, orbicular, spire conical or flattened; columella partly filled by a tongue-shaped callous process (funiculum) from the columella. Operculum horny. Animal capable of entire retraction within the shell. Inhabits mostly temperate seas. *N. duplicata*, Say (lxiii, 45).

ANOMPHALA, Jonas. (Cernina, Gray. Bulbus, Brown.) Globular, imperforate, the columella with heavy callous deposit. The animal is bulky, and unable to retract itself entirely into its shell. Operculum, if present, quite rudimentary. *N. fluctuata*, Sowb. (lxiii, 46).

AMPULLINA, Lam. (Globularia, H. and A. Adams. Ampulinopsis, Conr. Euspira, Agass., in part.) Umbilicus narrow (rimate), lined by a thin callus. Operculum with calcareous layer. *N. Sigaretina*, Lam. (lxiv, 66).

MAMILLA, Schum., 1817. (Ruma, H. and A. Adams. Naticaria, Swn.) Shell oval-conic, rather thin, with pointed spire; whorls fasciated; mouth oblong, inner lip narrow, reflected. usually brown or black; umbilicus not funiculated. Operculum cartilaginous, oblong, narrower than the aperture. Animal capable of retraction within its shell. *N. maura*, Lam. (lxiii, 47).

MAMMA, Klein. (Polinices, Montf. Naticella, Guild.) Shell oval or suboval, solid, smooth, spire short, sharp; aperture semicircular, inner lip oblique, callous, the callus extending into the umbilicus. Operculum corneous; animal retractile. *N. straminea*, Recluz (lxiii, 48). The shell of Mamma is usually white, sometimes colored, but not banded or spotted.

AMAURA, Möller. (Acrybia, H. and A. Adams. Ptychostoma, Laube.) Shell oval, smooth, imperforate, spire elevated, aperture oblong, columella short, simple. Operculum corneous, thin. The animal has a small, compact foot, without posterior lobe, anterior lobe profoundly sinuous, eyes at the internal base of the lobe. A boreal group, comprising a few living species. Fossil; Jurassic, Cretaceous, Tertiary. *N. candida*, Möller (lxiii, 46).

AMAUROPSIS, Mörch. Shell with canaliculated sutures. Scarcely distinct from Amaura. *N. canaliculata*, Gould (lxiii, 50).

AMAURELLA, A. Ad., 1867. Shell small, ovate, imperforate, white, shining, apex submamillary; aperture acuminate ovate; lip arcuate, simple, thick. 3 sp. Japan. *N. Japonica*, A. Ad.

LARINA, A. Adams. (Robinsonia, Nevill.) Shell thin, delicate, composed of a few rapidly increasing whorls; not umbilicated, columella simple, lip not reflexed. Epidermis olivaceous. Operculum horny, annular. Somewhat resembles Amauropsis. 6 sp. Indian Ocean, Australia. *N. Ceylonica*, Nevill (lxiii, 51). This is possibly a fresh-water shell, and perhaps belongs in Paludinidæ.

NATICOPSIS, M'Coy. (Neritomopsis, Waagen, 1880.) Shell imperforate; inner lip very thick, spreading. Operculum shelly. Carboniferous Limestone; Great Britain. *N. Phillipsii*, M'Coy (lxiv, 67).

ISONEMA, Meek. (Section of Naticopsis.) *I. humilis*, Meek (lxiv, 71). Devonian; Ohio.

TRACHYDOMIA, Meek and Worthen, 1866. (Section of Naticopsis.) Surface covered by small regularly disposed tubercles. *N. nodosa*, M. and W. Carboniferous; Illinois.

EUSPIRA (Agassiz), Morris and Lycett. (Holoepa, Hall, in part.) Spire more or less elevated; whorls few, distinct, angulated or carinated. Inferior Oolite; England. "Euspira presents considerable affinities to the Palæozoic genus Scalites, Hall, in the lines of growth having the appearance of a slight fissure, where the angle occurs in the volution."—MORR. and LYC. *N. canaliculata*, Morr. and Lyc. (lxiv, 84).

GYRODES, Conrad, 1860.

Distr.—Cretaceous; U. S., Europe, India. *G. alveata*, Conr. (lxiv, 70).

Shell depressed-globose; aperture generally angular or narrowly rounded below; inner lip thin; umbilicus wide, deep, without callosity, bounded by a revolving carina which is sometimes crenate, with occasionally a second small revolving ridge within; whorls shouldered above, the angle generally wrinkled or crenate.

CLOUGHTONIA, Hudleston.

Distr.—*C. (Phasianella) cincta*, Phillips. Oolite; England.

Shell short, conical and solid, with a widish base; whorls about five, flat and angular; body-whorl more or less bicarinated with slight depression of the intervening space; aperture ovate to ovate-oblong, rounded anteriorly; pillar nearly straight, with little or no callus.

This group seems to occupy an intermediate position between Natica and Chemnitzia.

TYCHONIA, de Koninck, 1881.

Distr.—*T. Omaliana*, de Kon. Carboniferous; Belgium.

Shell somewhat depressed, globular, smooth; spire short, obtuse, sutures shallow; last whorl very large; mouth semicircular, outer lip sharp, inner lip somewhat callous; an umbilical fissure.

SIGARETUS, Lam.

Syn.—*Catinus* (Klein), H. and A. Adams. *Lupia*, Conr. *Stomatia*, Hill. *Raynevallia*, Ponzi.

Distr.—90 recent sp. United States, West Indies, China, Peru. Fossil, 10 sp. Eocene—. *S. neritoideus*, Linn. (lxiii, 52).

Shell ear-shaped, with minute spire and very large aperture, externally with revolving striæ, color usually white, with sometimes a thin corneous epidermis. Operculum minute, horny, subspiral. Animal with large mantle partly or entirely covering the shell, anterior foot-lobe enormously developed.

They live on muddy sand-flats; in their habits they are sluggish and slow-moving, and very timid; when crawling they constantly explore the surrounding surface with the produced fore-lobe of the foot, which is also used in burrowing.

SIGARETUS, Lam. (typical). Shell orbicular, conoidal or convex; mouth rounded; umbilicus open or covered by a reflection of the inner lip; spire short, oblique.

NATICINA, Gray. (*Lacunaria*, Conr.) Shell oval-oblong, thin, ventricose; spire sharp; inner lip straight, thin anteriorly, with a median callus; umbilicus open or partly covered. *S. papilla*, Gmel. (lxiii, 53).

CRYPTOSTOMA, Blainv. Shell ear-shaped, flattened; spire short, depressed; mouth very large, oblique; no umbilicus. *S. haliooides*, Linn. (lxiii, 54).

VELUTINA, Fleming.

Etym.—*Velutinus*, velvety (from *vellus*, a fleece).

Syn.—(?) *Catinella*, Stache.

Distr.—4 sp. Boreal Seas, Europe and America. Fossil. Triassic, Cretaceous, Pliocene—. *V. capuloidea*, Blainv. (lxiii, 55). *V. lævigata*, Linn. (lxiii, 56).

Shell thin, with a velvety epidermis; spire small, sutures well-impressed; aperture very large, rounded; peristome continuous, thin. No operculum.

Animal with a large oblong foot; margin of the mantle developed all around, and more or less reflected over the shell; head broad; tentacles subulate, blunt, far apart, with eyes on prominences at their outer bases.

The Velutinas, although resembling the pulmoniferous genus *Otina*, are strictly marine, being met with sometimes far out at

sea; usually, however, they are found living on stones near low-water.

VELUTELLA, Gray. Shell thin, flexible, pellucid, smooth, membranaceous; spire somewhat elevated; mouth oblong, columella flexuous. *V. flexilis*, Mont. (lxiv, 86).

[**LIMNERIA**, H. and A. Adams. (*Morvillia*, Gray.) Shell semi-globose, with wide expanded aperture, sometimes extending posteriorly beyond the apex; inner lip oblique, reflexed posteriorly, straight and acute anteriorly. *V. zonata*, Gould (lxiii, 64, 65), which has been referred to the pulmoniferous genus *Otina*, is a typical species.]

LEPTONOTIS, Conrad. Differs from *Velutina* in the remarkable expansion of the outer lip, and the distance of the apex from the margin. *V. expansa*, Whitfield (lxiv, 68, 69). Eocene; Alabama.

AMPHLOSTOMA, Stoliczka. Subovate, thin, spire short; whorls few, the last large, ventricose, produced in front, widely excavated at base; aperture elongately ovate, subangulated, pillar-lip smooth, outer lip dilated and expanded at the margin; surface nearly smooth. Cretaceous; So. India, Europe. *A. auriforme*, Stoliczka (lxiv, 85).

PLATYOSTOMA, Conrad.

Distr.—*P. Niagarensis*, Hall (lxiv, 74). Niagara group, New York.

Shell subglobose; spire short; aperture very large, suborbicular, dilated; labrum joining the body-whorl at right-angles to the axis of the shell.

STROPHOSTYLUS, Hall. Shell subglobose or ovoid-globose; spire small, with a large, ventricose body-whorl; outer lip thin, not reflected (sometimes slightly expanded); columella twisted or spirally grooved within, not reflected; umbilicus none; aperture somewhat round-ovate or transversely broad-oval. Fossil. Lower Helderberg. *S. obtusus*, Hall (lxiv, 75). In this the columella is said to be twisted or spirally grooved within, whilst in *Platyostoma* the columellar lip is simply thickened.

ORIOSTOMA, Mun.-Chal., 1876. Umbilicus moderate, circumscribed by a carina; whorls sometimes partially free. *O. Barandei*, Mun.-Chal. Devonian.

[**LYSIS**, Gabb (p. 112), may perhaps be related to *Velutina*.]

LAMELLARIA, Montagu.

Etym.—*Lamella*, a thin plate.

Syn. (Larval form).—*Brownia*, d'Orb. (*B. Candeï*, d'Orb., lxxxvii, 8, 9). *Calcarella*, Souleyet (*C. spinosa*, Soul., xx, 51). *Jasonilla*, Macdonald. *Echinospira*, Krohn (*E. diaphana*, Kr., xx, 49, 50).

Distr.—10 sp. Norway, Great Britain, Mediterranean, New Zealand, Philippines. Fossil, 2 sp. Pliocene.

Shell ear-shaped; thin, pellucid, fragile; spire very small; aperture large, patulous; inner lip receding. No operculum.

Animal much larger than the shell, which is entirely concealed by the reflected margins of the mantle; mantle non-retractile, notched in front; eyes at the outer bases of the tentacles. Lingual uncini 3, similar; or one very large.

Lamellaria perspicua (lxiii, 57, 58) lays its eggs in February and March; it hollows out a nest in the colonies of the compound Ascidians, from which it derives its nourishment. The nest is closed by a transparent operculum, presenting circular and concentric striæ, showing that the animal turns round during oviposition. Each capsule contains besides the normal eggs a certain number of rudimentary ones, which later serve for the nourishment of the embryos. The first shell formed is nautiloid, presenting two dorsal and two lateral keels (xx, 49, 50); the second shell, formed within the first, is more simple, like a *Carinaria*: the two are united at their apertures by a thin membrane. —GIARD, *Comptes Rendus*, 736, 1875.

Dr. J. Gwyn Jeffreys remarks of the same species:—

The mantle, tentacles and foot assume different positions when the animal is quiescent and in active motion. It swims or floats with apparent ease. The gill-plume (whether single or double I could not make out) is of a yellowish brown color. Mr. Daniel found constantly in the stomach portions of branched corallines, probably indicating that the *Lamellaria* feeds on Polyzoa. According to Mr. Peach the female eats a round hole in a jelly-like compound Ascidian (*Leptoclinum punctatum*) for the purpose of making her nest and depositing in it her eggs. This nest is pot-shaped, and covered by a circular lid; it is at first bright yellow, which afterwards sometimes fades and changes, becoming at last dirty white. As the embryo increases in size the nest rises up beyond the surface of the Ascidian, having been previously covered on all sides. The spawn is deposited from February to May; it arrives at maturity in four or five weeks. The embryo, when enclosed and swimming in the glairy matrix, is of a somewhat triangular shape; the front portion is trilobed, each lobe being furnished with delicate vibratile cilia which are in constant motion; the central portion is granular, and the hinder bluntly pointed. On the pot-lid bursting open and the fry emerging, the latter is found to have a pellucid nautiliform shell, retaining in other respects the appearance of its fœtal state, and destitute of tentacles, eyes or foot. Mr. Peach's excellent observations were continued regularly for ten years. Every season the *Lamellaria*, as if impelled by the same instinct

which takes the salmon to the river, and the herring to shallower water, migrated inshore and sought its proper spawning ground.

MARSENINA, Gray. (? Colobocephalus, M. Sars.) Shell opaque, with short spire; animal with mantle fissured down the back. *L. depressa*, Sutton (lxiii, 59).

ONCHIDIOPSIS, Bergh. Shell entirely enclosed by the animal, thin, slipper-like, without spire, margin entire. Animal verrucose, with a lanceolate foot. *O. glacialis*, M. Sars (lxiv, 72, 73, Norway).

CRYPTOCELLA, H. and A. Adams. Shell thin, pellucid, calcareous; spire small, mouth very large; animal with depressed, subverrucose or smooth mantle. *L. tentaculata*, Mont. (lxiii, 60). *L. latens*, Müll. (lxiii, 61).

CORIOCELLA, Blainv. Shell spiral, calcareous, thin, subopaque, spire short, whorls rounded, the last large, aperture very large. Mantle of animal deeply fissured and bilobed in front, the surface depressed and covered with numerous hexagonal tubercles. This group was founded by Blainville upon an animal accidentally deprived of its shell. *L. nigra*, Blainv. (lxiii, 62, 63).

VANIKORO, Quoy and Gaimard.

Syn.—Narica, Recluz. Merrya, Gray. Leucotis, Sowb.

Distr.—25 sp. West Indies, Nicobar, Philippines, Polynesia. Fossil. Gault—; Europe, U. S. *V. cancellata*, Chemn. (lxv, 90).

Shell subglobose, external, white, with sometimes a velvety epidermis, striated, costate or decussated, umbilicated, umbilicus without a trace of callus. Operculum very thin, corneous, not spiral.

Probably most of the jurassic and triassic species of *Neritopsis* belong to Vanikoro, as certainly do nearly all the species described by Münster and Klipstein from St. Cassian under the name of *Naticella*. There are numerous cretaceous species from the old world.

VANIKOROPSIS, Meek. Shell subglobose, thick and solid; body-volution large; spire depressed; aperture ovate; axis imperforate; outer lip simple, beveled; inner lip closely folded upon, and adhering to, the columella and the body-volution, very little thickened and not flattened, toothed, notched, or serrated; surface with distinct revolving lines and furrows, and on the body-volution developing strong oblique folds or plications and furrows, parallel to the lines of growth. *N. Tuomeyana*, M. and H. (lxiv, 87). Cretaceous; Upper Missouri River.

NATICODON, Ryckholt. Shell globose like Vanikoro, but the inner lip usually thickened and always provided with some kind of a tooth; the columella is either slightly hollowed out or solid; the surface smooth or ornamented with various spiral or trans-

verse striæ. Palæozoic. A connecting link between Vanikoro and Neritopsis; the former having the columellar lip smooth, the latter insinuated in the middle, or provided with two strong teeth, while Naticodon has only one tooth; as regards the thickness of the shell this transition seems equally to hold good. *N. spiratum*, Sowb. (lxiv, 76). Carboniferous; Europe.

FAMILY CALYPTRÆIDÆ.

Shell limpet-like, with the apex more or less spiral; interior simple, or divided by a shelly process, variously shaped, to which the adductor muscles are attached.

Animal with a distinct head; muzzle lengthened; eyes on the external bases of the tentacles; branchial plume single. The rostrum is prominent and split, but non-retractile.

The bonnet-limpets are found adhering to stones and shells; most of them appear never to quit the spot on which they first settle, as the margins of their shells become adapted to the surface beneath, whilst some wear away the space beneath their foot, and others secrete a shelly base. Both their form and color depend on the situation in which they grow; those found in the cavities of dead shells are nearly flat, or even concave above, and colorless. They are presumed to feed on the seaweed growing round them, or on animalcules; a Calyptræa, which Professor Forbes kept in a glass, ate a small sea-slug (*Goniodoris*) which was confined with it. Both Calyptræa and Pileopsis sometimes cover and hatch their spawn in front of their foot.

The use of the calcareous lamina, which is the first stage in the formation of a columella, is to support the viscera and separate them from the foot or locomotive organ.

GALERUS, Humphrey.

Syn.—*Sigapatella*, Siphopatella, Lesson. *Mitella*, Leach.

Distr.—Tropical and subtropical. *G. Chinensis*, Linn. (lxvi, 22, 23). Fossil. L. Cretaceous—.

Shell depressed subconical, spiral, summit subcentral, aperture very large, basal, with a subspiral broad lamina adhering to the left margin. Animal with bilabiate muzzle, buccal appendages short, rounded; a slightly developed, plain-edged neck-lobe; foot auriculate in front.

GALEROPSIS, Conrad. Spire more elevated. *G. excentricus*, Gabb. Eocene.

INFUNDIBULUM, Montfort.

Syn.—*Trochita*, Schum., 1817. *Clypeola*, Gray. *Trochella*, Gray.

Distr.—Mostly tropical and subtropical. *I. spirata*, Forbes (lxvi, 24, 25). Fossil. Tertiary; U. S., West Indies.

Shell conic, trochiform, spiral; summit central; whorls convex, plicate, not umbilicated; aperture large, containing a spiral transverse lamina, extending obliquely from the centre to the outer margin of the shell. The animal has an oblong foot, bilobed anteriorly.

HALIOTIDEA, Swainson. Shell conic, spiral, the spire excentric, whorls convex, smooth, umbilicated. *I. dilatata*, Sowb. (lxvi, 26).

CALYPTRÆA, Lam.

Cup and saucer limpet.

Syn.—Cemoria, Risso. Mitrella, Trochilina, Trelania, Poculina, Gray. Mitrularia, Schum. Lithedaphus, Owen.

Distr.—Temperate and tropical; world-wide. *C. Martiniana*, Reeve (lxvi, 27).

Shell conical, more or less regular, with subcentral, subposterior sharp apex; aperture basal, with a central lamina, half cup-shaped, attached to the apex and open in front.

Animal with broad muzzle; tentacles rather short, lanceolate; eyes on bulgings at the outer bases of the tentacles; mantle-margin simple, sides plain.

CRUCIBULUM, Schum., 1817.

Syn.—Bicatillus, Biconia, Swains. Siphopatella, Lesson. Trelania, Neleta, Gray.

Distr.—Temperate and tropical; world-wide. *C. rudis*, Brod. (lxvi, 28).

Differs from Calyptrea in the internal cup-shaped lamina, which is entire and attached along a line on one side to the inner wall of the shell.

DISPOTÆA, Say. (Calypeopsis, Lesson.) Cup-shaped lamina adhering to the whole of one side. *C. striata*, Say (lxvi, 29).

CATILLINA, Gray. Oblong, conical, radiately ribbed; the apex acute, subcentral, recurved; nucleus regular, spiral; cavity conical, with a broad trigonal cup on the left side under, but not extending to the apex of the cavity, filled with a callous deposit at the tip; the part of the cup next to the inner surface of the shell scarcely thickened and not raised up. *Crucibulum concamerata*, Rve. (lxiv, 77).

CREPIDULA, Lam.

Etym.—*Crepidula*, a small sandal.

Syn.—Crypta, Humph. Sandalium, Schum. Crepipatella, Lesson (?). Tylacus, Lyroscapha, Conrad.

Distr.—50 sp. West Indies, Atlantic and Pacific Coasts of N. America, Mediterranean, W. Africa, India, Australia. *C. Peruviana*, Lam. (lxv, 91). Fossil. Cretaceous—

Shell oval, limpet-like, with a posterior, generally lateral spiral apex; interior with a shelly lamina covering its posterior half.

Animal. Head large, transverse, depressed; foot rounded, slightly truncate in front.

Adhering to shells or stones, and modifying their form in accordance with their dwelling-place, those species living within the aperture of empty spiral shells are generally flat and uncolored; others reproduce the ribs of Pecten; others again attach in groups upon the outside of each other's shells.

GARNOTIA, Gray. Oval, convex, covered by a smooth epidermis; apex dorsal, median, posterior; lamina inclined.

IANACUS, Mörch. Shell depressed, apex posterior, but slightly lateral; lamina mostly concave in front. *C. unguiformis*, Lam. (lxv, 92).

ERGÆA, H. and A. Adams. Shell depressed, summit lateral; lamina produced in front, its columellar margin subtubular. *C. plana*, Ads. and Rve. (lxv, 93).

NOICIA, Gray. Shell subcircular or oblong, convex, spiral; whorls one and a half or two; the apex subcentral, subposterior; nucleus spiral; cavity concave, deeper under the apex; internal plate concave, thin, with the fold forming a narrow linear cavity open to the apex of the shell. *N. Chinensis*, Gray. China.

SPIROCRYPTA, Gabb. Summit of shell posterior, lateral and submarginal, spiral. Internal plate attached to the margin on the lower or outer side, curving upwards and inwards and uniting with the opposite side at a considerable distance. The plate is subspiral, thus approaching Trochita and Galerus. *C. pileum*, Gabb (lxiv, 78). Cretaceous; Cal.

GALERICULUS, Seeley.

Distr.—*G. altus*, Seeley (lxiv, 79).

This genus has two separate septa, the larger one originating below the incurved apex, and the smaller one at the base. Only the cast is as yet known; the upper surface of the shell, which has the form of a Helcion, not having been observed.

CAPULUS, Montf.

Bonnet-limpet.

Syn.—Pileopsis, Lam. Actita, Fischer de Wald.

Distr.—8 sp. W. Indies, Europe, India, Australia, W. America. Fossil, 20 sp. Silurian.—*C. Ungaricus*, Linn. (lxvi, 30).

Shell conical, apex posterior, spirally recurved; aperture rounded; muscular impression horseshoe-shaped.

Tongue-membrane winged on each side in front, teeth arranged in seven series (3·1·3), central teeth small and broad with the apex hooked, the lateral teeth long and hamate. Rostrum lengthened; tentacles subulate, with the eyes on bulgings at their outer bases. Mantle simple in front; gill forming a single plume placed obliquely across the mantle-cavity, laminae elongate, linear, partly exposed. Foot folded on itself, the sides simple,

anteriorly thin and strap-shaped, posteriorly thick, orbicular and concave.

These animals are said to feed on the sea-weed that grows around them, and on small marine organisms. They appear to have but limited locomotion, being usually adherent and modifying the margin of the aperture of the shell according to the surface on which they live. Sometimes they wear away the surface beneath their foot, forming shallow excavations, or they secrete an imperfect shelly base by means of the same organ. The egg-cases are membranous and are attached in a tuft at the front of the foot under the neck.

THYCA, H. and A. Adams, 1854. Shell conical, transparent, slightly curved, with longitudinal grooves. Occurs on *Asteria*. *C. astericola*, Ad. and Reeve.

BROCCHIA, Bronn. Irregularly conical, apex slightly spiral; left margin with a profound sinus; posterior half of the margin folded. 2 sp. Tertiary. A doubtful group. *C. sinuosa*, Bronn (lxiv, 80).

PLATYCERAS, Conrad.

Syn.—Acroculia, Phillips.

Distr.—Fossil, 50 sp. Silurian to Carboniferous; United States, Europe. *P. ventricosum*, Conr. (lxiv, 81, 82).

Shell depressed subglobose, subvoid or obliquely subconical; spire small; volutions few, sometimes free and sometimes contiguous, without columella; aperture more or less expanded, often campanulate, and sometimes with the lip reflexed; peristome entire or sinuous. Surface striated or cancellated, often spirally ridged or plicate, and sometimes strongly lamellose transversely, nodose or spiniferous.

The subglobose species resemble the Velutinæ, but there is every degree of variation in form between these and non-spiral shells. From among these, two subgeneric groups have been rather arbitrarily separated.

ORTHONYCHIA, Hall. Body of the shell straight or curving, gradually diminishing above, arched or in some degree spiral at the apex, with the last volution or more quite free. Sil. to Carb. *P. spirale*, Hall (lxiv, 83).

IGOCERAS, Hall. Shell straight, with cancellated surface and often with the addition of longitudinal plications. Silurian. *P. pileatum*, Conrad.

BERTHELINIA, Crosse.

Distr.—*B. elegans*, Crosse (lxv, 94, 95). Fossil. Paris basin.

Capuliform, very small, microscopic, thin, rather smooth, few-whorled, the spire very small and lateral, the last whorl greatly dilated with a large aperture.

SPIRICELLA, Rang.

Distr.—*S. unguiculus*, Rang (lxv, 96, 97). Miocene; France. Shell flattened, elongated, with a small sinistrally spiral apex. Perhaps as nearly related to Umbrella.

AMATHINA, Gray.

Distr.—*A. tricarinata* (lxv, 98, 99). India.

Shell depressed, oblong; apex posterior, not spiral, with three strong ribs radiating from it to the anterior margin, which is produced into three points.

Head elongated; eyes sessile on the posterior lateral margins behind the tentacles; tentacles short, obtuse; mantle-margin entire, a tentacular median filament at the hind-part.

HIPPONYX, DeFrance.

Etym.—*Hippos*, a horse, and *onyx*, a hoof.

Syn.—*Cochlelepas*, Klein. *Krebsia*, Mörch.

Distr.—10 sp. W. Indies, W. America, Indian Ocean, Philippines, Australia. Fossil. 10 sp. Cretaceous; United States, Europe. *H. cornucopiæ*, Lam. (lxv, 100, 1, 2).

Shell thick, obliquely conical, non-spiral, apex somewhat posterior and curved backwards; muscular impression horseshoe-shaped; base of attachment shelly, secreted by the foot of the animal.

Animal oval or suborbicular, conical or depressed; foot very thin, a little thickened towards the margins; head globose, separated from the body by a neck-like constriction; eyes upon swellings of the tentacles.

AMALTHEA, Schum., 1817. (*Sabia*, Gray.) Like *Hipponyx*, but forming no shelly base; surface of attachment worn and marked with a crescent-shaped impression. Often occurs on living shells, such as the large *Turbos* and *Turbinellæ* of the Eastern seas. *H. conica*, Schum. (lxv, 3, 4).

FAMILY ONUSTIDÆ.

Shell conical, spiral, depressed, umbilicated, soldering shells and stones to its exterior surface.

Animal. Foot small, cylindrical, used for jumping, not walking, having an expanded front, and a tapering hind-portion. Operculum large, horny, subannular, right half free, nucleus lateral, dextral; muscular impression sinistral, semilunar, extending the whole length.

These animals scramble along like the *Strombs*; they extend and fix the front, dilated part of the foot and draw the hind-lobe up to it, throwing forwards the shell at every movement. They cannot glide like other mollusks, but the form of the foot is

admirably adapted to the nature of the floor on which they live, which is usually composed of the debris of dead shells.

ONUSTUS, H. and A. Adams.

Syn.—Haliphæbus and Tugurium, Fischer.

Distr.—Several sp. Tropical; East and West Indies. *O. solaris*, Linn. (lxvi, 31, 32). Fossil. Devonian—.

Shell conical, trochiform, depressed, widely and profoundly umbilicated; periphery of the whorls fringed with regularly disposed tubular spines or slight projections; pieces of small shells agglutinated upon the whorls at the sutures, where they are attached as growth continues.

EUTROCHUS, Whitfield, 1882.

Distr.—*E. concava*, Hall. Carb.; Ind., Ills.

Shell conical above, flat or concave beneath, and broadly and deeply umbilicated; aperture very oblique, and the outer angle of volutions strongly carinated or expanded; surface ornamentation unlike on the upper and lower surfaces.

Differs from the umbilicated forms of Trochidæ in not forming a columella; the lower or basal surface sloping gradually and smoothly into, and forming the sides of, the umbilicus, giving an obliquely elliptical section to the volution.

XENOPHORA, Fischer de Wald.

Syn.—Phorus, Montf. Pseudophorus, Meek.

Distr.—Several sp. Tropical. *X. conchyliophora*, Born (lxvi, 33). Fossil. Devonian—.

Shell conical, trochiform, whorls flattened, carrying shells, madrepores and stones, miscellaneously arranged and attached anywhere upon the exterior surface, so as to completely disguise the dorsal aspect of the shell; lower surface free of extraneous agglutinations; umbilicus narrow, sometimes covered by the inner lip.

The "carriers" inhabit deep water, and are most numerous in the Java and China Seas. Each species appears to have its own peculiar method of collecting the fragments of shells and stones which cover the ground where it lives, and each cements to the outside of the shell its particular kind of materials. The adventitious pieces of shell are so disposed as not to curve downwards beyond the edge of the shell, so as to impede the progress of the animal, but are usually placed with their concave sides uppermost, and the purpose of this structure is evidently concealment of the true nature of the animal, either for attack or defense, or perhaps for both occasions; as when tricked out with shells and stones it may well be mistaken for a refuse-heap.

ENDOPTYGMA, Gabb, 1877. Differs from Xenophora in having

a strong revolving plate inside, nearly midway between the umbilical and outer margin on the base. Cretaceous; Miss. and Alabama; described from a cast. *X. umbilicata*, Tuomey.

FAMILY SOLARIIDÆ.

Shell orbicular, depressed or trochiform; aperture generally angular; umbilicus usually wide and deep. Operculum corneous, spiral.

The animal has folded tentacles, with the suture below; eyes sessile on the upper surface of their bases; gill-cavity divided by a longitudinal fold; proboscis retractile.

The shells are not pearly like Trochus—which many of them resemble. They are numerous represented in fossil deposits, commencing in the Trias, and reaching their maximum in the Tertiary. There are not many living species. Dentition (xii, 39, 40).

SOLARIUM, Lam.

Etym.—*Solarium*, a dial.

Syn.—Architectonica, Bolten. Solariorbis, Conrad.

Distr.—25 sp. Tropical; world-wide. Fossil, more numerous. Commencing with the Eocene. *S. perspectivum*, Linn. (lxvi, 34).

Shell depressed conic, angular at the periphery; aperture subquadrangular, lip simple; umbilicus wide, spiral, its margins crenulated. Operculum horny, subspiral.

TORINIA, Gray. (Helicius, d'Orb.) Shell orbicular, elevated, granulated, last whorl rounded; moderately but profoundly umbilicated. Operculum conically elevated, of numerous volutions, which are margined by projecting edges cork-screw fashion. *S. variegatum*, Lam. (lxvi, 35).

Distinguished from Solarium by its spirally elevated operculum, and by the rounded periphery of the last whorl. They affect deep water, and are very shy and sensitive when under observation.

PHILIPPIA, Gray. (Disculus, Desh.) Shell smooth, subconic; umbilicus with crenulated margins. Operculum flattened, whorls numerous. *S. luteum*, Lam. (lxvi, 36).

GYRISCUS, Tiberi. Shell turbinated, conic-turriculated, umbilicated, rather obtuse, the summit enveloped. Whorls rounded, transversely sculptured. Aperture subcircular, the simple margins united by a callous deposit; columellar lip reflected. Operculum corneous, multispiral externally, furnished internally with a central styliform projection. *S. Jeffreysianum*, Tiberi (lxv, 5, 6). Mediterranean.

FLUXINA, Dall. Shell porcellanous, depressed conical, umbilicate, strongly carinate, with a stout umbilical rib, above which the pillar is thin and emarginate; from the umbilical rib to the

carina the basal margin of the aperture is deeply flexuously emarginate; above the carina it is again, but less deeply, emarginate, then sweeps forward roundly, and then slightly recedes before joining the preceding whorl. This curious form belongs in all probability to the Solariidæ, representing among them *Basilissa* among the Trochidæ, and recalling *Platyschisma*, but with a different aperture. When perfect, the margin at the carina must project forward like a claw or nail, as in *Schizosoma*. When adult, the nuclear whorls are filled up with a solid deposit of shelly matter, and it is probable that there is a slight notch at the end of the umbilical rib. *S. brunnea*, Dall. West Indies.

PLATYSCHISMA, M'Coy.

Distr.—Silurian—; U. S., Europe. *P. Uchtensis*, Keys (lxv, 7).

Shell depressed trochiform, whorls somewhat rounded, ornamented with small transverse ribs; spire short, whorls few; aperture oblique; umbilicus small, rounded.

ARCHITEA, Costa.

Syn.—*Trachysma*, Jeffreys.

Distr.—*A. delicatum*, Phil. (lxv, 8).

Shell turbate, but little elevated, thin, widely and deeply umbilicated below; aperture rounded, peristome continuous, simple. Operculum corneous, pellucid, spiral, flattened and smooth on the outer side, the spire slightly prominent in the centre of the inner side.

STRAPAROLLUS, Montfort, 1810.

Syn.—*Euomphalus*, Sowb. *Helicotoma*, Salter. *Pleuronotus*, Hall. *Helicites*, Schloth. *Centrifugus* and *Inachus*, His. *Cirrus*, Sowb. *Phanerotinus*, Sowb. (partim). *Omphalocirrus*, *Planicirrus*, *Echinocirrus* and *Trochocirrus*, Ryckholt. *Omphalotrochus*, Meek. *Phymatifer*, Kon. *Straparollina*, Billings.

Distr.—60 sp. Lower Silurian to Trias; United States, Europe, Australia. *S. Gualteriatius*, Vern. (lxv, 9). *S. calcar*, d'Orb. (lxv, 21).

Shells depressed, whorls angular or carinated, aperture subquadrangular, umbilicus wide, conical. Operculum shelly, multi-spiral.

It has been proposed by several conchologists to unite the genera *Straparollus* (= *Euomphalus*) and *Solarium* in one. When, however, we compare the large number of species of both these genera, it appears that the smooth or at least less ornamented surface of the shell, the constant want of a distinctly crenulated margin round the umbilicus, combined with the roundish form of the whorls of *Straparollus*, make its separation

from Solarium very desirable. Of many of the palæozoic Straparolli the opercula are known, and they very much resemble those of Torinia, being thick and composed of numerous lamellar volutions.

[MACLUREA, Emmons. Shell discoidal, sinistral, flattened above, rounded below; surface smooth or transversely striated. Probably more nearly related to Bellerophontidæ and Haliotidæ, in the vicinity of which it will be more fully described. *S. magna*, Lesueur (lxv, 10).]

SCHIZOSTOMA, Bronn. Shell dextral or sinistral, planorbiform, the whorls flattened or convex; aperture triangular or transverse, the margins sinuous above and below, uniting in a produced point at the periphery. *S. Puzosii*, Vern. (lxv, 11).

CÆLOCENTRUS, Zittel. Shell low conical, widely umbilicated, with rounded or angular whorls, having one or two series of tubercles or hollow spines; aperture round, with entire lip. Devonian to Trias. *S. Goldfussi*, d'Arch.

EUOMPHALOPTERIS, Roemer. Shell low conical, widely and deeply umbilicated; periphery seamed, with fine radial channels. Operculum shelly, concentrically striated and swollen externally, showing spiral whorls internally. *S. alatus*, His. U. Silurian.

[RAPHISTOMA, Hall. (*Helicotoma*, Salter.) Shell lenticular or orbicular, whorls flattened with a carination above; umbilicus moderate; outer lip with slight sinus at the keel. *S. striatus*, Hall. See p. 223.]

HELICOCRYPTUS, d'Orb.

Distr.—*H. pusillus*, d'Orb. (lxv, 12). Corallien.

Shell depressed orbicular, volutions on the same plane; the outer one nearly embracing the others, so that it shows a small depressed spire above, and a narrow umbilicus below.

Stoliczka places this genus near *Rotella*; it is perhaps as nearly related to that genus as to the Solariidæ.

ADEORBIS, S. Wood.

Distr.—10 sp. West Indies, China. Low-water to 60 fms. Fossil, 5 sp. Eur. *A. subcarinatus*, Mont. (lxv, 13).

Shell depressed orbicular, widely umbilicated; whorls not numerous, smooth or striate, the last sometimes angular; aperture rounded, the outer lip arcuated, simple, sharp. Operculum shelly, subspiral.

OMALAXIS, Desh.

Distr.—*O. supranitida*, Wood (lxv, 14).

Shell subdiscoidal, whorls distinctly carinate, peristome not continuous. Operculum elevated, multispiral.

HOMALOGYRA, Jeffreys.

Syn.—*Omalogyra*, Jeffreys. *Ammonicerina*, Costa.

Distr.—2 sp. Europe, Greenland. *H. atomus*, Phil. (lxv, 15, 16).

Shell planorbiform, with involute spire; whorls more or less angulated; mouth clasping both sides of the periphery. Operculum few-whorled, nucleus central.

Body flattened, tentacles wanting, eyes sessile behind the head.

CYRCULUS, Jeffreys.

Distr.—*C. striatus*, Phil. (lxvi, 37). Mediterranean.

Shell minute, discoidal; umbilicus large, profound. Operculum multispiral, corneous.

DISCOHELIX, Dunker.

Syn.—Orbis, Lea (not Blainv. or Laccp.). Bifrontia, Desh. Ilaira, H. and A. Adams. Platystoma, Hörnes.

Distr.—*D. zanclea*, Phil. (lxv, 17, 18). Fossil. Silurian, Liassic, Cretaceous, etc.

The genus was proposed for a liassic, discoidal shell, composed of quadrangular whorls, carinated and more or less crenulated on the upper and lower edges of the back, on which the striæ of growth are insinuated backwards.

OPHILETA, Vanuxem.

Syn.—Cyclogyra, Wood. Planaria, Brown. Discohelix, Adams and Chemn.

Shell planorbiform, discoidal, whorls numerous, slender, in contact.

Proposed for a palæozoic fossil of New York (*O. levata*, Hall, lxv, 19); to which may be added the recent *Discohelix foliacea*, Phil. (lxiv, 88, 89).

ECCYLIOMPHALUS, Portlock, 1843.

Syn.—Serpularia, Roemer. Phanerotinus (partim), Sowb., 1842.

Distr.—Fossil. Palæozoic, a few species. *E. serpula*, Kon. (lxv, 20).

Shell discoidal, whorls few, in the same plane, widely dissolute; flattened above, rounded beneath.

FAMILY SCALARIDÆ.

Characters those of the only genus. These mollusks are closely related to the Ianthinæ, of which they may be regarded as creeping representatives, on the one side, and to Turritella as well, by the form of their shell. Dentition xi, 36–38).

SCALARIA, Lam.

Etym.—*Scalaris*, like a ladder. Wentle-trap.

Syn.—Sthenorytis, Compsopleura and Scalarina, Conr.

Distr.—150 sp. Mostly tropical; Greenland, Norway, Britain, Mediterranean, West Indies, China, Australia, Pacific, West America. Fossil, nearly 200 sp. Trias—; Britain, North America, Chili, India. *S. pretiosa*, Linn. (lxvi, 42).

Shell mostly pure white and lustrous; turreted; many-whorled; whorls round, sometimes separate, ornamented with numerous transverse ribs; aperture round; peristome continuous. Operculum horny, few-whorled.

Animal with a retractile proboscis-like mouth; tentacles close together, long and pointed, with the eyes near their outer bases; mantle-margin simple, with a rudimentary siphonal fold; foot obtusely triangular, with a fold (mentum) in front. Sexes distinct; predaceous. Dr. Gould fed them on raw beef, which they eat voraciously; tongue armed with numerous simple uncini. Range from low-water to 80 fathoms. The animal exudes a purple fluid when molested.

CLATHRUS, Oken. Shell moderately thick, whorls united, longitudinal ribs numerous, aperture suboval, umbilicus covered by the left lip. *S. communis*, Lam. (lxvi, 38).

OPALIA, H. and A. Adams. (Psychrosoma, Tapparone-Canefri. Compsopleura, Conr.) Shell turriculated, imperforate, whorls united, the last with a spiral rib at the base. *S. coronata*, Lam. (lxvi, 39).

AMÆA, H. and A. Adams. Shell turriculated, thin, whorls united, cancellated, with some thin irregular varices; aperture semilunar, interior lip gibbous in the middle, exterior lip thin, simple. *S. magnifica*, Sowb. (lxvii, 45).

CIRSOTREMA, Mörch. Shell turriculated, solid, whorls cancellated, with a few irregular thick varices; mouth circular, outer margin of aperture thickened with an externally crenulated lip. *S. varicosa*, Lam. (lxvi, 40).

ACIRSA, Mörch. Shell turreted, thin, whorls united, varices obsolete, outer lip thin, simple. *S. Eschrichtii*, Holb. (lxvi, 43).

FUNIS, Seeley, 1861. Shell turreted, thin; whorls ornamented with transverse laminar ribbings and usually also with spiral striæ, so as to produce a cancellated surface; aperture ovate, with thin margins, anteriorly subeffuse. *S. elongata*, Seeley (lxvii, 46). Fossil. Cambridge Greensand; England. Intermediate between Sclaria and Turritella.

CROSSEA, A. Ad. Shell turbinate, umbilicated, white; whorls convex, cancellated, simple or with varices; aperture roundish, anteriorly angular, somewhat produced and canaliculated; umbilicus surrounded and narrowed by a callus. 2 sp. Japan. *S. miranda*, A. Ad. (lxvii, 47).

ACRILLA, A. Ad. Shell moderately thick, with very numerous, equal, transverse ribbings, base distinctly keeled at the periphery, outer lip thin. *S. acuminata*, Sowb. (lxvii, 48). East Indies.

CONSTANTIA, A. Ad. Acuminately oval, spire elate, whorls rounded, the last ventricose, decussated by thin longitudinal plications and revolving elevated liræ; aperture oval, its continuous margin free, acute. *S. elegans*, A. Ad. (lxvi, 41). Korea.

SCALIOLA, A. Ad. Animal with probosciform head; rostrum elongated, cylindrical, annulated; tentacles filiform; eyes prominent, black, at the external base of the tentacles; foot short, oval, acuminate behind. Operculum corneous, oval, subspiral, with subterminal nucleus. The shell agglutinates to its spire particles of sand, etc. *S. bella*, A. Ad. (lxvi, 44). Japan.

FAMILY IANTHINIDÆ.

Shell globular-turbinate, thin. No operculum. Animal pelagic, sustained by a vesicular natatory apparatus, called the float, and to which the eggs are attached (xvii, 99). Dentition (xi, 35).

IANTHINA, Lam.

Etym.—*Ianthina*, violet-colored.

Distr.—10 sp. Atlantic and Pacific Oceans. *I. communis*, Lam. (lxvii, 49; xvii, 99).

Shell thin, translucent, trochiform; nucleus minute, styliform; sinistral; whorls few, rather ventricose; aperture four-sided; columella tortuous; lip thin, notched at the outer angle. Base of the shell deep violet, spire nearly white.

Animal. Head large, muzzle-shaped, with a tentacle and eye-pedicle on each side, but no eyes; foot small, secreting a float composed of numerous cartilaginous air-vesicles, to the under surface of which the ovarian capsules are attached. Lingual ribbon, rachis unarmed; uncini numerous, simple (like *Scalaria*). Branchial plumes two. Sexes separate.

The Ianthinæ, or oceanic-snails, are gregarious in the open sea, where they are found in myriads, and are said to feed on the small blue acalephæ (Velella). When handled they exude a violet fluid from beneath the margin of the mantle. In rough weather they are driven about and their floats broken, or detached, in which state they are often met with. The capsules beneath the farther end of the raft have been observed to be empty, at a time when those in the middle contained young with fully formed shells, and those near the animal were filled with eggs. They have no power of sinking and rising in the water. The raft, which is much too large to be withdrawn into the shell, is generally thought to be an extreme modification of the operculum; but M. Lucaze-Duthiers, who has seen the raft formed, denies this. It is built up from glutinous matter secreted by the foot.

RELUZIA, Petit.

Etym.—Named in honor of Recluz, a French naturalist.

Distr.—2 sp. Red Sea, Atlantic, Mazatlan. *R. Rollandiana*, Petit (lxvii, 50).

Shell paludiform, thin, with a brown epidermis; whorls ventricose; aperture ovate-oblique, slightly effused at the base, margins disunited; inner lip oblique, rather sinuated in the middle; outer lip acute, entire. No operculum.

Animal pelagic, resembling *Ianthina*, and like it provided with a vesicular float.

SCALITES, Conrad.

Distr.—Silurian; United States. *S. angulatus*, Conr. (lxvii, 51).

Shell turriculated, whorls flattened above, angulated at the shoulder, and convex below; outer lip sinuous; umbilicus none, or very small.

RAPHISTOMA, Hall. Shell turbinated, depressed, flattened and angulated above, convex below; aperture subtrigonal, columellar lip excavated in the middle and produced to the right below. *S. staminea*, Hall (lxvii, 52).

HOLOPEA, Hall. (*Cyclora*, Hall.) Is a palæozoic group composed of incongruous elements. Its first species has been referred to *Littorinidæ*, another evidently belongs to *Naticidæ*, a third resembles *Ianthina*. The species are mostly casts. There appears to be no good reason for retaining the group.

FAMILY TRICHOTROPIDÆ.

Shell thin, turbinated, carinated, the ridges with epidermal fringes, in fresh or living specimens; columella obliquely truncated. Operculum lamellar, nucleus external.

Animal with a short, broad head; tentacles distant, with eyes on the middle; proboscis long, retractile. Dentition, central teeth single, hamate, denticulated; uncini three on each side, of which the inner is denticulate, the others simple.

TRICHOTROPIS, Brod.

Etym.—*Thrix* (trichos), hair, and *tropis*, keel.

Syn.—*Verena*, Gray. *Tropiphora*, Lovén. *Ariadna*, Fischer. *Trichophore*, Desh.

Distr.—15 sp. Circumboreal. *T. borealis*, Gould (lxvii, 53). Fossil. Cret.—

Characters those of the family.

IPHINOE, H. and A. Adams. Shell widely umbilicate, aperture subtriangular. *T. unicarinatus*, Sowb. (lxvii, 54).

ALORA, H. Adams. Shell ovate-fusiform, slightly umbilicated, thin; spire elevated; whorls convex, cancellated with elevated spiral ribs and thin lamellæ; aperture oval, slightly produced in front; inner lip smooth, rounded, slightly reflexed at the fore-part; outer lip simple, acute. *T. Gouldii*, A. Ad. W. Coast Central Am.

GYROTROPIS, Gabb. Cretaceous; North Carolina. Shell thin, resembling *Trichotropis* in form; spire elevated; umbilicus widely open, funnel-shaped; last whorl angulated above and below the periphery; covered with very thin foliated longitudinal varices. *G. squamosus*, Gabb.

FAMILY TURRITELLIDÆ.

Rostrum short, broad; tentacles long and subulate, the eyes slightly prominent on their external bases. Mantle with a fringed margin, obscurely siphonated at the right side; branchial plume single, very long. Foot very short, truncate in front, rounded behind, grooved beneath; operculigerous lobe simple.

Shell spiral, not umbilicated, spire very long, of numerous whorls, with revolving striae or carinations. Operculum corneous, multispiral.

TURRITELLA, Lam.

Screw-shell. *Etyim.*—Diminutive of *turris*, a tower.

Syn.—*Turris*, Humphrey. *Xylohelix*, Chemn.

Distr.—73 sp. World-wide. Ranging from the Laminarian Zone to 100 fathoms. West Indies, United States, Britain (1 sp.), Iceland, Mediterranean, West Africa, China, Australia, West America. Fossil, 172 sp. Triassic—; Britain, etc., N. and S. America, Australia, Java. *T. terebra*, Linn. (lxvii, 55).

Shell elongated, many-whorled, whorls rounded with revolving striae; aperture rounded. Operculum many-whorled, with a fimbriated margin. The shells are usually brown, with red-brown spots or flames.

TURRITELLOPSIS, Sars. Shell like *Turritella*, but the lingual dentition differs. A boreal group, doubtfully distinct. *T. acicula*, Stimpson (lxvii, 56).

HAUSTATOR, Montfort. Whorls flattened, mouth subquadrangular, outer lip sinuous. *T. goniostoma*, Val. (lxvii, 57).

TORCULA, Gray. Shell turriculated, usually white or horn-color, without markings; whorls subangular, with a median excavation; aperture subquadrangular, the outer lip with a slight median sinus. *T. cochlea*, Reeve (lxvii, 58).

ZARIA, Gray. Shell turriculated, without color-markings, whorls carinated; aperture subquadrangular, outer lip simple. *T. duplicata*, Linn. (lxvii, 59).

MESALIA, Gray. Shell turriculated, of numerous whorls; aperture oval, subcircular, slightly produced, with sinuous and reflected anterior margin; inner lip a little twisted and flattened, outer lip thin, sinuous posteriorly. *T. melanoides*, Reeve (lxvii, 60).

EGLISIA, Gray. Whorls rounded, with profound sutures; aperture rounded, rather small, inner lip flattened, callous, angular,

not reflected in front, outer lip somewhat thickened within. *T. lanceolata*, Reeve (lxvii, 61).

MATHILDA, Semper, 1865. Shell turriculated, apex revolute, abruptly turned from left to right; whorls in the typical species transversely cingulated and reticulated, longitudinally striated; aperture entire, subrotund, base sometimes subeffuse; lip acute; columella smooth. *T. cochlæformis*, Brugn. (lxvii, 62). Mediterranean; and several fossil species. Jurassic—; Europe, United States.

GLAUCONIA, Giebel, 1852. Shell turriculated, subulate; aperture small, rounded, peristome continuous, forming a posterior angle. Fossil. *T. Maraschini*, DeFrance (lxvii, 63).

CASSIOPE, Coquand, 1866. (Omphalia, Zekeli, 1852 [not Omphalius, Phil.]. Proto, authors, not DeFrance.) Shell thicker, and with more rapidly increasing whorls than in Turritella, often pupiform; aperture rounded, continuous; outer lip notched or sinuated by an impressed furrow, which winds round the last whorl; columella usually distinctly umbilicated. There are 30 cretaceous species. Europe, India and America. *C. Renevieri*, Coquand.

ARCOTIA, Stoliczka, 1868. Shell turreted, elongated, somewhat thickened; whorls spirally striate; incremental striæ straight, not sinuated; columella excavated; aperture angulately rounded, subeffuse anteriorly. *T. Indica*, Stol. (lxvii, 64). Jurassic and Cretaceous; India.

PROTOMA, Baird, 1870.

Distr.—*P. Knockeri*, Baird. Whydah, W. Africa.

Shell turreted, aperture oval, narrowly excised at the base. Operculum circular, corneous, multispiral.

The operculum shows this to belong to the Turritellidæ, although the aperture of the shell is more like that of Terebra.

LITHOTROCHUS, Conrad.

Approaching Mesalia, but without the produced basis of the last whorl of that genus. There is a thickened sutural band, with very numerous growth-striæ. Has much the appearance of an elongated Trochus. Liassic. *L. Humboldtii*, Buch. (lxvii, 65, 66). South America.

COCHLEARIA, Münster.

Syn.—Chilocyclus, Braun.

Distr.—2 fossil sp. Triassic; Austria. *C. carinata*, Bronn (lxvii, 67).

Shell turriculated, thick; aperture rounded, peristome continuous, widely and flatly reflected all around.

Zittel considers this a group in the family Scalaridæ.

FAMILY VERMETIDÆ.

Animal with rudimentary foot, head long, with two long conical tentacles, and eyes at their outer bases; proboscis retractile; on the sides of the buccal orifice are additional tentacles or buccal appendages, also conical. Operculum circular, sometimes spiral.

Shell tubular, attached; sometimes regularly spiral when young; always irregular in its adult growth; tube repeatedly partitioned off; aperture round.

The Vermetidæ are distinguished from the very similar shells of the annelid genus *Serpula* by the presence of a spiral, nuclear shell and of concave smooth interior septa. The shell of *Serpula* is composed of two calcareous layers, that of Vermetidæ of three.

VERMETUS, Adanson.

Shell irregularly spiral, or contorted tubular; free, or attached by one side like some of the annelids; operculate.

The following subgenera were considered distinct genera by Mörch:

VERMICULUS, Lister. (*Vermetus* of authors, not Adanson.) The shell is in its early stage regularly coiled like a *Turritella*, and afterwards with the last whorl uncoiled, variously twisted, or more or less straight and prolonged. There is apparently no other distinction between the shells of *Vermiculus* and *Burtinella*, except that the latter are coiled in a broad, largely umbilicated cone. 15 sp. Carboniferous—living. Tropical and subtropical. *V. lumbricalis*, Linn. (lxvii, 68).

BURTINELLA, Mörch. (*Mörchia*, Mayer.) Adult shell free, young affixed, thick, widely conically elevated, trochiform or planorboid, usually sinistral, rarely dextral; whorls regularly increasing in size, tubular within, angular without; the last whorl dissolute, more or less prolonged, not constricted; aperture circular, margin continuous. Fossil, 15 sp. Oolitic, Cretaceous, Tertiary; Europe, India. *B. concava*, Stol. (lxvii, 69, 70).

STREPHOPOMA, Mörch. Adult shell affixed, solitary or clustered; aperture slightly inflexed above, very obsoletely effused below. Operculum arcetispiral, furnished with long multifid setæ. Recent, 4 sp. *S. rosea*, Quoy (lxvii, 71). The shells are generally very small, and usually so tender as to be very rarely found fossil in a good state of preservation. Difficult to distinguish from *Vermiculus*.

TUBULOSTIUM, Stoliczka. Shell free, planorboid to broadly conical, aperture contracted, prolonged in a tube. 4 sp. Jurassic; Europe. Tertiary; United States. Cretaceous; India. *T. callosum*, Stol. (lxvii, 72, 73).

SIPHONIUM, Browne. (*Stoa*, M. de Serres.) Shell adherent,

irregularly twisted, carinated. Operculum large, smooth, circular, concave; the scar of attachment central, rugose. 23 sp. World-wide. M. Rougemont has observed at Naples that the *S. maximum* (lxvii, 74) emits from its mouth a thin veil-like plaited substance, which entangles small natatory animals, and is subsequently withdrawn.

VERMETUS, Adanson. (Macrophragma, Carp. Aletes, Carp.) Shell mostly spirally twisted, affixed, usually decussated, columella folded. Operculum thin, concave, scarcely spiral. The Vermetus of most authors is the Vermiculus of Lister. 27 sp. Widely diffused. *V. carinatus*, Quoy (lxvii, 75).

PETALOCOCHUS, Lea. An American tertiary fossil. Shell with two internal ridges running spirally along the columella, becoming obsolete near the apex and aperture. *V. sculpturatus*, Lea (lxvii, 76).

THYLACODES, Guettard. (Serpulorbis, Sassi. Lementina, Gray. Hatina, Gray. Cellularia, Schmidt. Cladopoma, Gray. Tetranemia, Mörch.) Shell tubular, irregularly twisted, adherent, aperture rounded, columella not plicate. No operculum, or minute when present. The animal has a truncated foot, produced in front into tentacular processes. Many living and several tertiary species; and one cret.; India. *T. arenaria*, Quoy (lxvii, 77).

BIVONIA, Gray. Shell affixed, mostly spiral, aperture contracted, circular, with spiral, interruptedly nodulose liræ, and a median elevated line; columella smooth. Operculum small, rudimentary. Animal with cylindrical tentacles, pedal filaments subulate or setaceous. 7 sp. *B. triquetra*, Bivona (lxvii, 80). When the shells are not perfect with the margin of the aperture, they are very difficult to distinguish from Spirogyphus.

SPIROGLYPHUS, Daudin. Animal forming a groove on the surface of shells or stones, covering it over with shelly matter, and forming a tubular case. Many zoologists consider the Spirogyphus to be an annulose animal allied to Serpula, but of this there is no positive proof. The young animal, when first hatched, is covered with an ovate, regular shell, consisting of a whorl and a half; it soon attaches itself to the surface of some stone or other shell, in which it forms a canal, at first shallow, but afterwards deeper. *S. spirorbis*, Dillw. (lxvii, 78).

SILICULARIA, Brug.

Etyim.—*Siliqua*, a pod. *Syn.*—Tenagodus, Guettard.

Distr.—15 sp. Mediterranean, Australia. Fossil, 20 sp. Tertiary. The typical species, as well as several others, occur imbedded in sponges. *S. anguina*, Linn. (lxvii, 79).

Shell tubular; spiral at first, afterwards irregular; tube with a continuous longitudinal slit. Operculum spiral, like that of

Torinia, composed of a spiral band ciliated at the margin, forming a cylinder or cone, the axis of which is filled up by a series of spiral radiating cells.

PYXIPOMA, Mörch, 1860. Slit closed by a lamella, but not filled up outside. *S. lacteus*, Lam. Australia.

AGATHIRSES, Montf., 1810. The band composed of numerous isolated holes. Chiefly fossil. *S. squamosa*, Lam.

CRYPTOBIA, Desh. Proposed for a tubular shell, with spiral commencement, formerly supposed to be constructed by an annelid. It is believed to be related to *Pyxipoma* by Mörch, but its true nature is by no means clearly established. *S. Michelini*, Desh. Isle of Bourbon.

FAMILY CÆCIDÆ.

Shell with a fugacious spiral nucleus; tubular, regular, minute. Operculum horny, multispiral, margin sometimes fimbriated.

Animal. Lingual membrane short; teeth in two series (2·0·2), central denticles none, the lateral uncini with the inner one broad and serrulated. Rostrum long and flat; tentacles short, subclavate at the tips; eyes sessile behind the bases of the tentacles. Mantle thick, fleshy, circular, closely embracing the neck; a single branchial plume. Foot short, narrow, truncate in front, obtuse behind. Not at all shy, progressing with great vivacity.

CÆCUM, Fleming.

Syn.—Anellum, Carp. Cæcalium, Macg. Odontidium, Phil. Fartulum and Elephantulum, Carp. Brochina, Gray. Corniculina, Munster. Brochus, Browne. Odontina, Zborzewsky. Dentaliopsis, Clark. Odontidium, Phil.

Distr.—42 sp. Europe, United States, West Indies, Mazatlan, Australia, Japan, Mauritius. Fossil, 8 sp. Eocene—. *C. cornuoides* (lxvii, 81). *C. pulchellum*, (lxvii, 82).

Young shell spiral in one plane, afterwards an arcuated tube, truncated posteriorly by the loss of the spiral portion, and closed there by a convex septum.

P. P. Carpenter proposed subgenera for species distinguished by differences of sculpture, but M. de Folin, who has recently studied the Cæcidæ, points out that these groups are not founded on permanent characters, the various species exhibiting a series from smooth to ribbed surfaces.

BROCHINA, Gray. Founded on a single species, and insufficiently characterized by its convex operculum.

MIOCERAS, Carpenter, 1858. Young shell loosely spiral, not in one plane; adult shell somewhat inflated, aperture oblique; operculum externally concave. The species are all smooth, the adult resembling in shape the horn of an ox. *C. cornucopiæ*, Carp.

STREBLOCERAS, Carpenter, 1858. Shell not decollated, the permanent nucleus lying in a plane perpendicular to the adult tube. *C. cornuoides*, Carp.

PARASTROPHIA Folin. (Moreletia, Folin.) Nuclear whorls subspiral in one plane, as in the typical group, but persistent; tube inflated anteriorly.

FAMILY EULIMIDÆ.

Animal having slender, subulate, simple tentacles, with eyes sessile at their outer bases; mantle enclosed, with rudimentary siphonal fold; foot linguiform, produced in front.

Shell turriculated or turbiniform, smooth, milk-white, polished; aperture oval or rounded, sometimes angular in front; columella without plications. Operculum, when present, corneous, subspiral.

EULIMA, Risso.

Etym.—*Eulimia*, ravenous hunger.

Syn.—*Pasithea*, Lea (in part).

Distr.—49 sp. Britain, Mediterranean, India, Australia, Pacific. In 5–90 fathoms water. Fossil, 40 sp. Carb.?—; Britain, France, etc. *E. tortuosa*, Ads. (lxviii, 83).

Shell small, white, and polished; slender, elongated with numerous level whorls, spire often curved to one side; obscurely marked on one side by a series of periodic mouths, which form prominent ribs internally; apex acute; aperture oval, pointed above; outer lip thickened internally; inner lip reflected over the pillar, not umbilicated. Operculum horny, subspiral.

Animal, tentacles subulate, close, with the eyes immersed at their posterior bases; proboscis long, retractile; foot truncated in front, mentum bilobed; operculum lobe winged on each side; branchial plume single; mantle with a rudimentary siphonal fold.

The *Eulimæ* creep with the foot much in advance of the head, which is usually concealed within the aperture, the tentacles only protruding.—FORBES.

APICALIA, A. Adams, 1862. Apex more mucronated, spire more distorted. *E. gibba*, A. Ad. Japan.

EULIMOPSIS, Brugnone. Shell small, fusiformly turreted, subacute; base striate, whorls scarcely convex, with superficial sutures; aperture rhombovate, lip sinuous, columella contorted. *E. Carmelæ*, Brugnone (lxviii, 84). Pliocene; Sicily.

ARCUELLA, Nevill. (Bacula, H. and A. Adams.) Differs from the typical *Eulima* by having spiral striæ, and the columella twisted back so as to form an acute angle at the base of the aperture. *E. mirifica*, Nevill (lxviii, 85). Mauritius.

IOPSIS, Gabb. Differs from *Eulima* in its faintly twisted columella, which is produced in front so as to form a short,

though not notched canal. *E. fusiformis*, Gabb (lxviii, 86). Tertiary; W. I. The existence of a sutural band shows this group to be properly placed in Eulimidæ.

LEIOSTRACA, H. and A. Adams.

Syn.—Balcis, Leach.

Distr.—A few subtropical species. W. Indies, Mazatlan, etc. *L. subulata*, Donovan. (lxviii, 87).

Shell subulate, turriculated, whorls a little flattened, smooth, polished, a slight varix on each side of the spire; aperture oblong, entire; inner lip distinct, callous, a little sinuous in the middle, outer lip flexuous.

MUCRONALIA, A. Ad. Shell subulate, straight, pupoidal, the apex mucronate; whorls simple, aperture oblong. *Distr.*—5 sp. *L. exilis*, A. Ad. Japan.

SELMA, A. Ad. Shell oblong-ovate, subdiaphanous, spire short, last whorl large; aperture elongately ovate, columella arcuate, obliquely subuplicate. 1 sp. Japan.

EUCHRYSALIS, Laube, 1866.

Distr.—6 sp. Fossil. Jurassic, Cretaceous; Europe, India. *E. bisulcata*, d'Orb.

Differs from Leiostraca by being pupoid, attenuated towards each end and thickened in the middle; last whorl large, much contracted posteriorly, aperture proportionally very small. Surface generally smooth; inner lip somewhat thickened and arcuate, outer lip sharp, sinuous.

[PUTILLA, Adams.

Shell turbinate, solid, pellucid; aperture subquadrate, anteriorly subeffuse, inner lip straight, thickened, columella rimate. I have arranged this genus in Rissoidæ, but it may belong here.]

NISO, Risso.

Syn.—Bonellia, Deshayes. Janella, Grateloup.

Distr.—China, W. America. Fossil. Cretaceous; Eocene of Paris. *N. gonistoma*, Ads. (lxviii, 88).

Shell turriculated, smooth, polished, apex very sharp; umbilicus perforated or wide; aperture small, angulated above and below.

ORINA, A. Ad. Shell conoidal, profoundly umbilicated, white, thin, smooth, whorls flattened, aperture subquadrate, with a single columellar plait.

PALÆONISO, Gemm., 1878. Shell long, oval, cylindrical, outer lip with a posterior sinus. *N. pupoides*, Gemm. Lias.

CLIMACINA, Gemm., 1878. Turreted, without umbilicus, first whorls scalariform, mouth oval, angular behind, rounded in front. *N. Catharinæ*, Gemm. Lias,

VOLUSIA, A. Ad., 1861. Shell longitudinally ribbed. *N. imbricata*, Sowb.

STYLIFER, Brod.

Syn.—*Stylina*, Gray.

Distr.—20 sp. Europe, West Indies, Polynesia, Philippines. *S. subulatus*, Brod. (lxviii, 89).

Shell hyaline, pellucid, thin, globular or subulate, smooth, polished; whorls numerous; apex very sharp, sometimes bent, nucleus sinistral; aperture suboval, angulated posteriorly, rounded in front; inner lip smooth, arcuated; outer lip slightly sinuous, thin, simple. No operculum.

Tentacles slender, subulate, simple, eyes sessile at their outer bases. Mantle enclosed. Foot linguiform, forming an elongated anterior lobe; rudimentary behind.

These singular animals are found among the species of *Echinus*, and in the skins of star-fishes, etc., burrowing beneath the surface, and producing tumors, often of considerable size. When removed and placed in water, they do not appear to possess much locomotive power, but extend the tongue-shaped foot and use it as an exploring organ. They were formerly believed to be parasitic, but are now thought to receive their food in the sea-water. Tongue unarmed.

The foot of *Stylifer* is much more produced anteriorly than that of *Eulima*: the shells have more globose whorls, and are generally thinner.

CYTHNIA, Carpenter. Imbedded in star-fishes like *Stylifer*, from which it is distinguished by its normal nuclear whorls, and thin concentric operculum. *S. tumens*, Carp. 3 sp. W. Coast of N. America.

PLICIFER, H. Ad. Imperforate, ovately subulate, not shining; spire styliform, nucleus sinistral, columella plicate; lip flexuous, sinuate behind, aperture entire in front. Found by Mr. Hugh Nevill on coral, at Ceylon; in texture resembles the shell of *Leptocoelus*. *P. Nevilli*, H. Ad. (lxviii, 90). Ceylon.

ENTOCONCHA, J. Müller.

Distr.—*E. mirabilis*, J. Müller.

Shell obovate, smooth; spire short, very obtuse, apex not elevated, whorls rapidly increasing; aperture transverse, semilunar, angulated above, rounded below, width almost equaling the height, margins disunited, the columellar margin straight. Operculum non-spiral.

Found parasitic on *Synapta digitata*, one of the *Holothuriidæ*, at Trieste. This is possibly the larval stage of some mollusk.

MACROCHEILUS, Phillips.

Etym.—*Macros*, large, and *cheilos*, lip.

Syn.—*Polyphemopsis*, Portlock. *Amarella*, A. Ad. *Plectostylus*, Conrad. *Macrochilina*, Bayle, 1880.

Distr.—Several sp. *M. Japonicus*. Japan. Fossil, 12 sp. Devonian to Carboniferous; Britain, Belgium, United States. *M. Schlotheimii*, d'Arch. (lxviii, 91).

Shell thick, ventricose, buccinoid; aperture simple, effuse below, outer lip thin, inner lip wanting, columella callous, slightly tortuous.

I follow Woodward in making *Polyphemopsis* a synonym of this genus; but it is a very doubtful fossil, the surface of the type being worn off.

PASITHEA, Lea (restricted), 1833. Spire short, last whorl ventricose. Rather more slender and cylindrical than the typical *Macrocheilus*. *M. Claibornensis*, Lea. Eocene; Ala.

SUBULITES, Conrad, 1842.

Distr.—12 sp. Palæozoic; N. Am. *S. elongata*, Conrad.

Shell smooth, resembling a very much elongated *Terebellum*, but the exact form of the aperture is unknown. If this be really rounded and entire in front, the genus may be placed in this family; in the contrary case it may belong to the *Pyramidellidæ* or possibly to the *Alata*.

STROBEUS, Koninck, 1881.

Distr.—3 sp. Carb.; Belgium.

Shell small, long oval, smooth; spire pointed, of 5-7 convex whorls; mouth long oval, outer lip sharp; inner lip callous, with an anterior fold.

HOPLOPTERON, Fischer.

Distr.—*H. Terquemi*, Fischer (lxviii, 93). China Sea.

Shell imperforate, elongate-turreted, shining, apex obtuse; upper whorls plain, lower ones with triangular, flat, projecting wings on each side; aperture entire, the margin acute, columella without plaits.

Probably an embryonic shell (?). It is only 1.15 mill. long.

SUBEULIMA, Souverb.

Distr.—*S. Lamberti*, Souverb. (lxviii, 94). New Caledonia.

Shell turreted, elongated, whorls numerous, angulated and carinated in the middle; spire tortuous as in *Eulima*.

SCALENOSTOMA, Deshayes.

Distr.—*S. carinatum*, Desh. (lxviii, 95). Isle of Bourbon.

Shell in form allied to *Pyramidella* and *Niso*, turriculated, white, imperforate; columella not plicated; opening subtriangular, slightly bent in the direction of its length; margin simple, notched near the suture.

BULIMORPHA, Whitfield, 1882.

Syn.—*Bulimella*, Hall (not Pfeiffer). *Polyphemopsis*, Portlock, in part.

Distr.—3 sp. Carb.; Indiana. *B. bulimiformis*, Hall.

Shell fusiform, spire produced; volutions convex, the last large; columella bent and truncated at the base, where it is separated from the outer lip by a notch, as in the recent genus *Achatina*; outer lip very slightly notched near the upper end; surface of the shell smooth.

CHEMNITZIA, d'Orb., 1850.

Etym.—In honor of Chemnitz, a distinguished Nuremburg conchologist, who published seven volumes in continuation of Martini's "Conchylien Cabinet," 1780–1795.

Distr.—Fossil only, 250 sp. World-wide. Triassic—. *C. condensata*, Desh. lxviii, 96).

Shell comparatively large, elongate-conical; spire many-whorled, not reversed at the apex; last whorl moderately large, somewhat produced below; aperture ovate, sometimes faintly effuse at base; peritreme not continuous; outer lip sharp, with usually a faintly sinuous outline near or above the middle; columella smooth; imperforate; surface with longitudinal costæ or lines, sometimes crossed by revolving striæ—rarely nodular.

I restrict *Chemnitzia* to the fossil group so known, and which appears to have been most nearly related to the *Eulimidæ*. The much smaller sized ribbed recent species which have been referred to this genus, and which d'Orbigny actually included in his earliest definition of it, are distinguished under the name of *Turbonilla*, Risso. They do not possess the broad posterior insinuation of the outer lip characteristic of *Chemnitzia*.

CHEMNITZIA (restricted). Shell lengthened with cross-ribs; mouth oval, rounded or angular in front; spire straight or slightly curved, somewhat callous; outer lip sharp. *Ch. similis*, Münt.

RHABDOCONCHA, Gemmellaro, 1878. Whorls striate or ribbed longitudinally, which are sometimes punctate or tuberculate. *C. crassilabrata*, Terq.

PSEUDOMELANIA (Pictet), Gemmellaro, 1878. Shell long, thick; whorls smooth, with fine curved growth-lines; mouth rounded or angular in front; spire straight or slightly curved. *Ch. Normannia*, d'Orb.

COONIA, Gemmellaro, 1878. Shell egg-shaped, smooth, with growth-lines; last whorl large; mouth oval, rounded in front; spire slightly curved. *Ch. Cornelia*, d'Orb.

MICROSCHIZA, Gemmellaro, 1878. Shell usually with cross-ribs; narrowly perforated; whorls sharp, mostly scalariform; mouth oval, rounded in front; inner lip and spire callously thickened. *C. Philenor*, d'Orb.

LOXONEMA, Phillips.

Etym.—*Loxos*, oblique, and *nema*, thread; in allusion to the striated surface of many species.

Syn.—*Michelia*, Römer. *Holopella*, Sandb. (in part).

Distr.—Fossil, 75 sp. L. Silurian—Trias; North America, Europe. *L. costatum*, Sandb. (lxviii, 97).

Shell elongated, many-whorled; aperture simple, attenuated above, effused below, with a sigmoidal edge to the outer lip.

Like many other palæozoic genera, the bad condition of many of the species and the variation in form and sculpture render it difficult to place it properly in a systematic work; some of the species might go into *Turbonillidæ*, others appear closely allied to *Chemnitzia*, and might even be synonymous with it.

ORTHONEMA, Meek and Worthen, 1861.

Distr.—Several fossil species. Devonian, Carboniferous; U. S. *O. Salteri*, Meek.

Shell elongate, many-whorled; volutions ornamented with revolving carinæ, crossed by nearly straight lines of growth; body-whorl not produced below; aperture angular above, slightly effuse below; peristome incomplete; lip simple, nearly straight; axis imperforate.

Differs from *Turritella* in its slightly effuse and less rounded aperture, disconnected peristome, and straight outer lip. It is probably more nearly allied to *Loxonema*, but has distinct revolving carinæ, and wants the sigmoid outer lip of that genus.

BOURGUETIA, Desh.

Distr.—*Phasianella striata*, Sowb., etc. Jurassic.

Shell large, turreted; spire long, pointed; whorls convex, spirally striated or grooved; last whorl large; mouth oval, angular behind, widened and rounded in front.

FAMILY TURBONILLIDÆ.

Animal with a short head, triangular tentacles, and eyes at their outer bases; proboscis long, retractile; foot truncated in front.

Shell white, slender, elongated, many-whorled, mostly longitudinally ribbed or spirally striate. Operculum horny, sub-spiral.

The animal differs from that of *Eulimidæ* and resembles that of *Pyramidellidæ*, but the shell is, in the recent species, usually more slim than *Pyramidella*, and without columellar folds, or with a single small fold. It differs from *Eulima* in being sculptured.

Most of the recent species are of quite small size.

TURBONILLA, Risso.

Syn.—*Chemnitzia*, d'Orb., 1839, not 1850. *Pyrgiscus*, Phil. *Orthostelis*, Arad.

Distr.—50 sp. World-wide. Range from low-water to 90 fathoms. Fossil. Cretaceous—. *T. elegantissima*, Mont. (lxviii, 98).

Shell slender, elongated, many-whorled; whorls plaited; apex sinistral; aperture simple, ovate; peristome incomplete, columella not plaited. Operculum horny, subspiral.

Animal. Head very short, furnished with a long, retractile proboscis; tentacles triangular; eyes immersed at the inner angles of the tentacles; foot truncated in front, with a distinct mentum, operculigerous lobe with a minute conical appendage on each side.

Comprises a great number of small, graceful white shells which have been grouped in a number of genera or subgenera.

MORMULA, A. Ad. Subulately-turreted, rissoid, solid, thick, longitudinally plicate; aperture large, columella spirally tortuous, lip thickened within, margin acute. A few Japanese species. *T. rissoina*, A. Ad.

DUNKERIA, Carpenter, 1857. (In honor of W. Dunker, a distinguished German conchologist.) Whorls rounded, cancellated. Numerous species. Mazatlan, Japan. *T. paucilirata*, Carp. Mazatlan.

VANESIA, A. Ad., 1861. Proposed for two species resembling *Melania* in external characters, but true marine shells, decussated by longitudinal and spiral ridges. *T. trifasciata*, Sowb. China.

SPIROCLIMAX, Mörch. Subcylindrical, pellucid, suture contabulate, aperture ear-shaped, lip thickened, sigmoidal, submarginate, inflexed at the suture. 1 sp. West Indies.

MIROBELICUS, Sandb. *T. inaspecta*, Fuchs.

STREPTACIS, Meek, 1871.

Distr.—*S. Whitfieldi*, Meek. Carb.; Ills.

Shell small, turreted, smooth; embryonal whorls planorbiform; mouth oval.

HOLOPELLA, M'Coy, 1852.

Etym.—'olos, entire, and ope, an aperture.

Distr.—Fossil, 12 sp. Silurian, Trias; Europe, United States. *H. gregaria*, Sowb.

Shell elongated, slender, of numerous gradually increasing whorls, generally crossed by slightly arched striæ; mouth circular, with the peristome entire; base rounded, with or without a minute umbilicus.

The shells of the species composing this genus differ from those of *Turritella* in the continuous peristome and definite round margin to the aperture, thus approaching much nearer to *Scalaria*.

EULIMELLA, Forbes,

Distr.—Eur., Japan. *E. Scillæ*, Scacchi (lxviii, 1, 2).

Shell elongated, turriculate, solid, smooth, polished, whorls

numerous, apex sinistral; aperture subquadrangular, lip not continuous, columella straight, not plicate.

STYLOPTYGMA, A. Ad., 1860. Shell inflated about the middle of the spire, thus becoming somewhat pupiform; smooth, or slightly ribbed. *E. stylina*, A. Ad. Japan.

ANISOCYCLA, Monts.

Syn.—*Aciculina*, Deshayes (not Ads.).

Distr.—6 sp. Eocene; Paris basin. *A. gracilis*, Desh. (lxviii, 100). Closely allied to *Eulimella*.

Shell small, aciculated; apex laterally inclined; whorls numerous, convex, smooth; aperture entire, small, subquadrangular; columella straight, narrow, cylindrical, and simple.

ACLIS, Lovén.

Etym.—*A*, without, *kleis*, a projection.

Syn.—*Alvania*, Leach (not Risso). *Cælatura*, Conrad. *Cioniscus*, Jeffreys. *Pherusa*, Jeffreys. *Actæonema*, Conrad.

Distr.—*A. nitidissima*, Mont. (lxviii, 92). Fossil, 12 sp. Devonian—; Europe, United States.

Shell minute, like *Turritella*; usually spirally striated; apex sinistral; aperture oval; outer lip prominent; axis slightly rimate. Operculate.

Animal with a long retractile proboscis; tentacles close together, slender, inflated at the tips; eyes immersed at the bases of the tentacles; operculum lobe ample, unsymmetrical; foot truncated in front.

EBALA, Leach. Shell smooth, rimate. *A. diaphana*, A. Ad.

HEMIACLIS, Sars. Shell glabrous, turreted, rimate, lip arcuate. Synonymous with *Ebala* (?). *A. ventrosa*, Jeffreys (lxviii, 99).

RISSOPSIS, Garrett. Shell small, thin, elongate, cylindrical; apex truncate; aperture subovate, angular above, entire; peristome rather thin, somewhat expanded; columella oblique, arched. *R. typica*, Garrett (lxviii, 3). Viti and Samoa Isles.

IOLÆA, A. Ad. Resembles *Niso*, but has a remarkably thin, spirally sulcated shell. Deep water. *I. scitula*, A. Ad. (lxviii, 4). Japan.

ODOSTOMIA, Fleming.

Etym.—*Odous*, a tooth, and *stoma*, mouth.

Syn.—*Odontostoma*, Phil. *Odontostomia*, Jeffreys.

Distr.—Species numerous, distribution universal, from low-water to 40 fathoms. Fossil, 15 sp. Eocene—. *O. nitida*, Alder (lxviii, 5.)

Shell subulate or ovate, typically smooth; apex sinistral; aperture ovate; peristome not continuous; columella with a single tooth-like fold. Operculum horny, indented on the inner side.

Animal elongated, the head large and robust, bearing two conical tentacles with eyes at their bases, foot depressed, truncated in front.

Very minute, usually smooth shells, having the habit of Rissoæ, and like them sometimes found in brackish water.

PARTHENIA, Lowe, 1863. (Pyrgulina, A. Ad.) Shell thin, turriculated, imperforate, usually milk-white under a very pale thin epidermis; whorls ribbed or striate, sometimes cancellate, vanishing at the periphery of the last whorl. 25 sp. Mazatlan, Japan. *O. monocycla*, A. Ad.

MIRALDA, A. Ad., 1863. Solid, ovate or elongated; whorls flat, plicate behind, transversely lirate in front; lip subangulate behind, margin crenate. Several Japanese species. *O. diadema*. A. Ad.

MUMIOLA, A. Ad., 1863. Shell thin, elongate or ovate; whorls convex, cancellate or granulose; aperture ovate, lip-margin regularly arcuate. 3 Japanese species. *O. spirata*, A. Ad.

AURICULINA, Gray. Shell oval, thin, bulimiform; whorls smooth or concentrically striate; columella not plicate. 6 sp. Mazatlan, Japan. Fossil, 4 sp. Tertiary; U. S. *O. cylindracea*, Alder (lxviii, 6). May possibly be a member of the family Actæonidæ.

LIOSTOMIA, Sars. Shell rimate, smooth; operculum paucispiral. 2 sp. Norway. *L. eburnea*, Stimpson (lxviii, 17, 18). Massachusetts.

CHRYSTALLIDA, Carpenter. Shell pupiform, usually cancellated; peristome continuous; edge of lip thin; columella-plait distinct, though hidden; operculum in the typical species radiately corrugated. 25 sp. E. and W. Indies, Japan, Mazatlan. *O. communis*, C. B. Ad. (lxviii, 7).

DOLIELLA, Monts. Shell Doliiform, apex immersed.

PYRAMIS, Couthouy.

Syn.—Menestho, Möller. *Type.*—*P. striatus*, Couth. (lxviii, 8).

Shell turriculated or elongated, with revolving striæ; mouth oval, small; columella with a rudimentary plication, sometimes obsolete.

MONOPTYGMA, Gray (not Lea). Having a sinuous columellar plication. *P. casta*, Ads. (lxviii, 9).

CARELOPSIS, Mörch. Shell turriculated, having the form of *Carelia Cumingii*.

OSCILLA, A. Ad.

Distr.—4 Japanese species. *Obeliscus annulatus*, A. Ad.

Shell solid, ovate or pyramidally turreted; imperforate; whorls strongly transversely lirate; aperture ovate or subquadrate; parietal plication strong, transverse, median.

ELUSA, A. Ad., 1861.

Distr.—China, Japan. *E. teres*, A. Ad.

Shell subulate, turreted; whorls longitudinally plicate; aperture ovate, inner lip with a single plait, outer lip frequently lirate within.

SYRNOLA, A. Ad., 1860.

Distr.—10 sp. Japan. *S. gracillima*, A. Ad.

Shell subulate, straight, vitreous, banded, polished; whorls flat, suture impressed; aperture oblong, inner lip obliquely plicate in the middle, outer lip simple, acute. They are readily distinguished from the more oval *Odostomia*—the species of which are white and destitute of colored markings. *Syrnola*, in fact, are small slender *Obelisci* with a single columellar plait.

AMATHIS, A. Ad., 1861. Subulate, smooth, polished, aperture dilated, rounded, acute behind, inner lip with a single plication. 6 sp. Japan. *S. Virgo*, A. Ad.

SYRNOLOPSIS, Smith.

Distr.—*S. lacustris*, E. A. Smith (lxviii, 15, 16). The only species, from Lake Tanganyika, E. Africa (fresh water), is yellowish horn-color, banded with white beneath the suture.

Shell subulate, smooth, imperforate; aperture broadly sinuated at the base, outer lip sinuous, slightly thickened, produced below, furnished far within with one or two prominent liræ; columella with a distinct plait. Operculum unknown.

FAMILY PYRAMIDELLIDÆ.

Shell turriculated, columella with several anterior plications. Operculum corneous, subspiral, the columellar margin sinuated.

Animal with broad-shouldered, ear-shaped tentacles, connate at the base; eyes immersed at their inner sides; mantle enclosed, with a rudimentary siphonal fold; foot produced and truncate anteriorly, with a fold or mentum in front. Lingual teeth none, or rudimentary.

The Turbonillidæ, just described, have been usually referred to this family, and in fact their distinction is one of convenience only, the number of columellar plications or their absence being characters of small importance.

“The Pyramidellidæ present subjects of much interest to the student of extinct mollusca; numerous forms, bearing all the aspect of being members of this family, occur among the fossils of even the oldest stratified rocks. Many of them are gigantic compared with existing species, and the group, as a whole, may be regarded rather as appertaining to past ages than the present epoch.”—FORBES.

PYRAMIDELLA, Lam.

Etym.—Diminutive of *pyramis*, a pyramid.

Distr.—25 sp. W. Indies, Australia, Japan. *P. plicata*, Lam. (lxviii, 11). Fossil. Cretaceous.

Shell turriculated, spire elevated, longitudinally ribbed; columella with three anterior plications; outer lip sharp, sometimes plicate within.

The Pyramidellæ live in sandy bays and on shallow mud-banks, concealing themselves under the surface, and indicating their presence by the formation of slender raised tracks.

OBELISCUS, Humphrey. Differs from Pyramidella in being smooth instead of ribbed. *P. maculosa*, Lam. (lxviii, 12).

TIBERIA, Jeffreys. Shell umbilicated. *P. minuscula*, Monts. Deep Sea. Mediterranean.

LONCHÆUS, Mörch. Shell imperforate, last whorl with a median sulcus.

TRIPTYCHUS, Mörch. Shell subulate, paucilirate spirally; aperture lirate within; columella with three small anterior plications.

NERINÆA, DeFrance.

Etym.—*Nereis*, a sea-nymph.

Syn.—Itruvia, Stolicz. Itieria, Matheron.

Distr.—Fossil, 150 sp. Jurassic, Cretaceous; Britain, France, Germany, Spain, and Portugal. They are most abundant, and attain the largest size to the south; and usually occur in calcareous strata, associated with shallow-water shells. *N. trinodosa*, d'Orb. (lxviii, 10). *N. trachea*, Desh. (lxviii, 13).

Shell elongated; many-whorled, nearly cylindrical; aperture channeled in front; interior with continuous ridges on the columella and whorls.

NERINÆA (restricted). Folds simple: 2–3 on the columella; 1–2 on the outer wall; columella solid, or perforated. Above 50 sp.

NERINELLA, Sharpe. Columella solid; folds simple; columellar, 0–1; outer wall, 1.

TROCHALIA, Sharpe. Columella perforated, with one fold; outer wall simple, or thickened, or with one fold; folds simple.

PTYGMATIS, Sharpe. Columella solid or perforated, usually with 3 folds; outer wall with 1–3 folds, some of them complicated in form.

HALLOYSIA, Briart and Cornet. Shell elongated, turriculated, whorls numerous, axis widely perforated, aperture rounded or subquadrangular, columella biciplicated. *H. biciplicata*, B. and C. (lxviii, 14). Calcaire grossier of Mons, Belgium.

SOLENIUSCUS, Meek and Worthen, 1860.

Etym.—*Soleniskos*, a little channel or gutter.

Distr.—*S. typicus*. Upper Coal Measures; Springfield, Illinois. Shell fusiform, smooth, body-whorl contracted below into a distinct straight canal, with an oblique plait on the columella.

Agrees with Macrocheilus in its smooth surface and columella-

fold, but differs in its fusiform outline, narrow aperture, and distinct canal. In its general appearance resembles *Fasciolaria*, but has only one instead of two or three columella-folds, and is destitute of ornamentation, and its outer lip is smooth within.

CRYPTOPLOCUS, Pictet and Campiche, 1854.

Etym.—*Cryptos*, hidden, *ploce*, a plait.

Distr.—7 sp. Jurassic and Cretaceous; France, Switzerland, Germany. *C. monilifera*, d'Orb.

Shell as in *Nerinaea*, without columella and labial plaits; one plait on the posterior face of the aperture, a disposition very analogous to that in some *Cerithiums*, such as *C. nodulosum*; aperture rounded, not channeled in front; umbilicated or imperforate.

APTYSIS, Zittel, 1873.

Syn.—*Pachystylus*, Gemmellaro, 1878.

Distr.—*A. sexcostata*, d'Orb. Jurassic.

Shell turreted, nearly cylindrical, not umbilicated; mouth lengthened quadrangular; inner and outer lips without folds; columella with a median fold-like thickening.

FAMILY LITTORINIDÆ.

Shell spiral, turbate or globular; peritreme entire, interior not nacreous.

Operculum corneous, spiral or paucispiral.

Animal having a probosciform head with terminal mouth, and conical tentacles, subulate, with eyes at their outer bases.

The species inhabit the sea, brackish or fresh water, some being amphibious. They are mostly littoral, feeding on algæ. Den-tition (xi, 26).

LITTORINA, Ferussac.

Etym.—*Littoralis*, belonging to the sea-shore. Periwinkle.

Syn.—*Bacalia*, Gray. *Isonema*, Hall (in part).

Distr.—175 sp. *L. littorea*, Linn. (lxix, 19). The periwinkles are found on the sea-shore in all parts of the world. In the Baltic they live within the influence of fresh water, and frequently become distorted in consequence; similar monstrosities are found fossil in the Norwich crag of England.

Fossil. Rather numerous; Miocene—. Probably some of the older fossils referred to *Turbo*, etc., belong to this genus.

Shell turbinated, thick, pointed, few-whorled; aperture rounded, outer lip acute, columella rather flattened, imperforate. Operculum paucispiral, lingual teeth hooked and trilobed; uncini hooked and dentated.

The foot is divided by a longitudinal line and in walking the sides advance alternately. The periwinkle and trochus are the food of the thrush, in the Hebrides, during winter. The lingual canal of the periwinkle passes from the back of the mouth under the œsophagus for a short distance, then turns up on the right side, and terminates in a coil (like spare rope) resting on the plaited portion of the gullet. It is $2\frac{1}{2}$ inches long, and contains about 600 rows of teeth; the part in use, arming the tongue, comprises about 24 rows.

The species above referred to, *L. littorea*, is an exceedingly numerous mollusk of Northern Europe; it appears to have become naturalized on the New England coast, where its area is rapidly increasing. It is largely consumed as an article of food in Europe, not only at the sea-ports and fishing villages, but even at the great capitals; 1900 tons of it being sold annually in London and employing a thousand persons in gathering it. It is also extensively used as bait, and to keep the oyster grounds clear of sea-weed—for which purpose the Essex oystermen regularly distribute many bushels of winkles over their grounds.

Many of the large species, including the above and the American species *L. irrorata*, Say, are in a great measure amphibious, living on the rocks along the shore, where they are washed by the tide. Several individuals of a West Indian species, survived deprivation of water for more than a year in my cabinet.

MELARAPHIS, Muhlfeldt. Shell rather thin, conical, with pointed spire; surface with revolving striæ, and usually variegated with brilliant colors. Tropical and subtropical. *L. angulifera*, Linn. (lxix, 20).

NERITOIDES, Brown. (*Neritrema*, Recluz.) Shell short turbinated or subglobose; spire very short, with obtuse apex; solid, inner lip much thickened and excavated. *L. obtusata*, Linn. (lxix, 21).

CYCLONEMA, Hall. Shell somewhat thinner than in the living Littorinæ. Palæozoic. 40 sp. U. S., Europe. *L. cancellata*, Hall (lxix, 22).

RAULINIA, Mayer, 1864. Shell turbate, ovate-oblong, rather thin, spirally sulcate; aperture ovate-oblong, margin simple, angulate behind, subeffuse in front; columellar lip wide, arcuate, with a central tooth. Fossil. Paris basin. A living Australian species. *L. alligata*, Desh. (lxix, 23).

A large number of palæozoic, mostly smooth shells like *Platystoma*, Conr., *Holopea*, Hall, *Macrocheilus*, Phillips, etc., which are generally referred elsewhere, may very probably belong to Littorinidæ.

TECTARIUS, Valenciennes.

Syn.—*Monodonta* (partim), Lam. *Pagodus*, Gray. *Pagodella*, Swains.

Distr.—Tropical. World-wide. *T. pyramidalis*, Quoy (lxix, 24).

Shell conical ovate or turbinated, surface tubercular or muricated, frequently angulated or biangulated on the middle of the last whorl; aperture striated within; axis usually imperforate. Operculum paucispiral, with a broad membranous border.

ECHINELLA, Swains. (Nina, Gray.) Depressed trochiform, more or less distinctly umbilicated. Operculum multispiral. *T. Cumingii*, Phil. (lxix, 25).

EUCYCLUS, Deslongchamps. (Amberleya, Morris and Lycett.) Shell very thin, spire elongated, almost turriculated; lip semi-circular, thin; columella flattened; imperforate. 23 sp. Jurassic, Liassic; Europe. *E. obeliscus*, Desl. *Amberleya* has priority but is insufficiently characterized.

BRACHYTREMA, Morris and Lycett. Shell small, turreted, turbinated; whorls either costated, nodulated, or cancellated; the last whorl large and ventricose; columella smooth, rounded, twisted near its base, and reflected outwards, forming a short, oblique canal; aperture moderately subovate, its length being usually less than that of the spire. Some species, as *B. varicosa* and *B. pygmæa*, acquired at certain arrests of growth thickened outer lips or varices, as in Triton. 16 sp. Lias; Europe. This form has been referred to the Cerithiidae, but its shape, aperture and sculpture all remind one of Tectarius; indeed, I doubt if it be really distinct from Eucyclus.

MODULUS, Gray.

Distr.—10 sp. W. Indies, W. tropical America, Philippines. *M. tectum*, Gmel. (lxix, 27).

Shell top-shaped, spire depressed, ribbed or tubercular, rather thin; narrowly umbilicated; columella with an anterior curved tooth. Operculum spiral.

Animal with eyes on the middle of the tentacles.

RISELLA, Gray.

Distr.—10 sp. Australia. *R. melanostoma*, Gmel. (lxix, 28).

Shell depressed trochiform, with flattened whorls and keeled periphery; not umbilicated; aperture rhomboidal, marked with brown inside the margin. Operculum paucispiral.

These shells are distinguished from Trochus, which they resemble in form and sculpture, by their non-nacreous interior; the animal by eyes on the tentacles instead of on peduncles, and by the absence of the lateral membranes of the foot.

PLESIOTROCHUS, Fischer. Shell imperforate; conic-elongate, not varicose; whorls numerous; aperture subrhomboidal, smooth

within, not nacreous, prolonged into a short canal below; lip subrostrated in the middle; columella edentulous. Operculum corneous, paucispiral. *R. Souverbianus*, Fischer (lxix, 29). New Caledonia.

LIMNOTROCHUS, E. A. Smith. Shell trochoid, umbilicated, without an epidermis, spirally ridged; aperture non-lirate within, with the outer lip oblique, the basal margin broadly sinuated, and the columella-edge somewhat reflexed and united to the labrum above by a callosity. Operculum horny, paucispiral. 2 sp. Lake Tanganyika, E. Africa. *R. Thomsoni*, E. A. Smith (lxix, 30). Remarkably like the genus *Plesiostrochus* described above; indeed it would be difficult to separate them, except by the locality; this, with other very curious forms imitating marine genera, occurs in fresh water, as above.

MICRODOMA, Meek and Worthen.

Distr.—*M. conica*, M. and W. (lxix, 26).

Shell small, rather thick, conical, imperforate, composed of flattened whorls, the last one of which is more or less angular around the middle and little produced below; aperture about as high as wide; outer lip simple, straight and oblique in outline; columella without folds or plications, inner lip thin and slightly reflected at the base of the columella. Surface with revolving nodular ridges.

CYCLOCHEILA, Conrad.

Distr.—1 sp. Tertiary; So. America.

Pyramidal; aperture circular; labrum expanded, columella flattened, subangular at the base; periphery angular; a very doubtful little shell, probably fresh water.

LACUNA, Turton.

Etym.—*Lacuna*, a fissure. *Syn.*—*Temana*, Leach.

Distr.—16 sp. Northern shores, Norway, Britain, Spain, United States. Fossil. Eocene—. *L. pallidula*, Da Costa (lxix, 31).

Shell turbinated, thin; aperture semilunar; columella flattened, with an umbilical fissure; operculum paucispiral.

Animal. Operculigerous lobe furnished with lateral wings and tentacular filaments. Teeth 5-cusped; uncini 1, 2, dentated, 3 simple. Spawn vermiform, thick, semicircular. Range, low-water to 50 fathoms.

The *Lacunæ* feed upon sea-weed, and Lovén observes that when the fucus is of a brown color, the animals become green, but if red, they assume a rosy tint.

EPHERIA, Leach. Shell thin, with revolving colored bands; spire rather elevated; inner lip thin, sharp. *L. vineta*, Turton (lxix, 32).

MEDORIA, Leach. Shell conical, solid, with elevated spire; peritreme dilated, anteriorly reflected; inner lip thick, flattened; umbilical fissure obsolete. *L. turrita*, A. Ad. Japan.

ERSILIA, Monts. 1 sp. Mediterranean.

HELA, Jeffreys. (Cithna, Jeffreys.) Shell shaped like Lacuna, with a similar operculum; but it has no epidermis; apex truncated or flattened, and instead of an umbilical canal or groove there is merely a narrow chink. Tentacles ciliated. *L. tenella*, Jeffreys (lxix, 33). Europe.

Hela being preoccupied in another department of zoology Jeffreys changed the name to Cithna—already used by Mr. A. Adams for a somewhat similar shell. I restore the original designation. Mr. Jeffreys being already honored with a generic name in Conchology, I cannot pay him the compliment usually tendered those who apply preoccupied names to new forms.

STENOTIS, A. Ad., 1863. Shell compressed, elongately ovate, auriform; spire short, acute; whorls flattened, the last solute; aperture oblong, narrow behind, margin continuous, acute; umbilicus patulous, its margin angulate. *L. laxata*, A. Ad. Japan.

LACUNARIA, Conrad. Ovate-conoid or subglobose, thin, with delicate, close, revolving lines; aperture entire, rounded or round-ovate, angulated posteriorly, margins disunited; columella flattened, with a long groove descending from the umbilicus. Eocene; United States and France. *L. Alabamensis*, Whitfield (lxix, 34).

SPIRONEMA, Meek. (Callonema, Conrad.) Shell ovate; whorls rounded, and separated by a rather deep suture; aperture ovate, lip thin, continuous; columella not thickened, perforated by a very small umbilicus; surface with revolving lines and furrows. *L. tenuilineata*, Meek and Hayden (lxix, 35). Cretaceous; U. S.

LACUNELLA, Deshayes. Shell oval, thin, pellucid, shining, apex obtuse; aperture large, dilated, with thin, expanded margin; columella narrow, thin, concave, divided by a narrow channel, scarcely perforate at the base. *L. depressa*, Desh. (lxix, 36). Eocene; Paris basin.

CREMNOCONCHUS, Blanford.

Syn.—Cremnobates, Blanf., preoccupied in fishes.

Distr.—3 sp. India, upon rocks wetted by fresh water. *C. Syhadrensis*, Blanf. (lxix, 37, 38).

Shell perforate, turbinately globose, ribbed; aperture subovate, margin simple, columella scarcely callous. Operculum testaceous, paucispiral.

Animal small, having a short proboscis, two short tentacles with eyes on swellings at their outer bases, foot short and

rounded. The dentition corresponds with that of the Littorinidæ.

FOSSARUS, Philippi.

Syn.—Phasianema, Wood. Maravignia, Aradas. Megalomphalus, Brusina.

Distr.—43 sp., including species of the subgenera. Mediterranean, W. America, Polynesia, Japan, Red Sea. Fossil, 4 sp. Miocene; Europe. *F. costatus*, Brocchi (lxix, 39). *F. ambiguus*, Linn. (lxix, 40).

Shell perforated, sculptured; inner lip thin; aperture semilunate. Operculum not spiral.

Animal with two frontal lobes between the tentacles.

ISAPIS, H. and A. Adams. Shell umbilicated, spire elevated, cancellated or with revolving ribs, columella with a small median tooth (almost obsolete in *F. anomala*). 4 sp. West Indies, Mazatlan. *F. anomala*, C. B. Ad. (lxix, 41).

FOSSARINA, Adams and Angas. Aperture circular, inner lip arcuated. 2 sp. Australia. *F. patula*, Ad. and Angas (lxix, 41).

COUTHOUYIA, A. Ad., 1860. Shell ovate, profoundly and widely rimate; spire acuminate; whorls convex, decussated, with impressed sutures; aperture semioval; inner lip straight, dilated in front, outer lip arcuate, simple. Japan. 3 sp. *F. decussata*, A. Ad.

CONRADIA, A. Ad., 1860. Shell turbate, rimately umbilicate, spire somewhat elate; whorls convex, carinated concentrically; aperture round the outer margin fimbriate, inner lip without teeth; umbilicus margined by a semilunar rib. 6 sp. Japan. *F. cingulifera*, A. Ad.

GOTTOINA, A. Ad., 1863. Lirate, solid, imperforate. 2 sp. Japan. *F. sulcifera*, A. Ad.

CITHNA, A. Ad., 1863. Globosely turbate, thin, whorls smooth, umbilicus margined. 2 sp. Japan. *F. globosa*, A. Ad.

FOSSARIOPSIS, Laube, 1870. Distinguished from Fossarus by the closed umbilicus and the callous expansion of the inner lip. *F. rugoso-carinata*, Klipst. Triassic.

TUBA, Lea. Shell conical, umbilicate; whorls rounded, cancellated; aperture rounded, margin not continuous above; columella thickened and reflected at the base. *F. alternata*, Lea (lxix, 43). Eocene; U. S.

ATRESIUS, Gabb, 1869.

Distr.—*A. liratus*, Gabb. Cret.; Cal.

Shell elongate, spire elevated; whorls rounded; aperture ovate, slightly produced in front, outer lip entire, thin; columella not callous, imperforate; surface marked by revolving ribs. Possibly belongs in Cerithiidae.

FAMILY PLANAXIDÆ.

Shell oval-conic, spire elevated, spirally striate; columella flattened, anteriorly truncate; lip rounded, simple, notched in front. Operculum corneous, subspiral.

Animal with a rather long rostrum, subulate tentacles, and eyes on swellings at their base, foot short, plain in Planaxis, with tentacular filaments in Litiopa.

PLANAXIS, Lam.

Distr.—44 sp. West Indian, Indo-Pacific, Polynesian, Panamic. *P. sulcatus*, Lam. (lxix, 44). Fossil. Tertiary.

Shell oval-conic, solid, with elevated spire; usually spirally ribbed; columella callous, flattened, truncate at base, with a narrow sinus; interior of aperture ridged; base notched.

Amphibious, crawling on stones near the margins of pools left dry by the retiring tide. Some of the species inhabit mangrove swamps, and may be seen adhering to the roots above the surface of the water.

HINEA, Gray. Shell smooth, covered by a yellowish brown epidermis; whorls flattened, outer lip thick, sillonated within. *P. Braziliana*, Lam. (lxix, 45).

QUOYIA, Desh. (Fissilabra, Brown. Leucostoma, Swains.) Shell solid, elongated, whorls flattened, spirally striated, apex decollated; mouth small, slightly notched in front, sillonated within; columella smooth, truncate anteriorly, with a sharp spiral posterior callus. *P. decollata*, Quoy (lxix, 46).

HOLCOSTOMA, H. and A. Adams. Shell thin, aperture furnished with a posterior canal which extends up the last whorl; it is covered with an epidermis curiously adorned with rows of golden bristles. *P. piligerum*, Phil. (lxix, 47).

LITIOPA, Rang.

Etym.—*Litos*, simple; *ope*, aperture.

Distr.—10 sp. Pelagic. Atlantic and Mediterranean, on floating sea-weed, to which they adhere by threads. *L. bombyx*, Rang. (lxix, 48). Fossil. Tertiary.

Shell minute, pointed; aperture slightly notched in front; outer lip simple, thin; inner lip reflected; operculum spiral.

The singular little oceanic mollusks which constitute this genus have the power of spinning glutinous threads by which they occasionally suspend themselves from the stems of floating sea-weed, among which they take up their abode; if the thread by any chance becomes divided, the animal emits a bubble enveloped in a glutinous secretion, which rises to the surface, drawing out threads as it ascends, and finally becomes attached to the weeds above.

ALABA, H. and A. Ad., 1862.

Distr.—24 sp. Japan, Australia, Mazatlan, West Indies. *A. tervaricosa*, C. B. Ad.

Shell ovate, conical or elongated, subdiaphanous; whorls plicate or varicose, apex submamillate; aperture ovate, the columella more or less truncate.

DIALA, A. Ad., 1862. Whorls not varicose, sometimes noduled around the middle; columella straightish, not truncated; labrum not thickened. 5 sp. Philippines, Australia, Japan. *A. varia*, A. Ad.

STYLIFERINA, A. Ad., 1860. Diaphanous, conical-turreted; whorls smooth, convex; apex mucronate; aperture subquadrate; inner lip straight. 2 sp. Japan. *A. orthochila*, A. Ad.

FAMILY CERITHIIDÆ.

Shell spiral, elongated, many-whorled, frequently varicose; aperture channeled in front, with a less distinct posterior canal; lip generally expanded in the adult; operculum horny and spiral.

Animal with a short muzzle, typically not retractile; tentacles distant, slender; eyes on short pedicels, connate with the tentacles; mantle-margin with a rudimentary siphonal fold; tongue armed with a single series of median teeth, and three laterals or uncini. Marine, estuary, or fresh water.

CERITHIUM, Bruguiere.

Etym — *Ceration*, a small horn.

Distr.—136 sp. Marine. World-wide, the typical species tropical. Norway, Britain, Mediterranean, West Indies, India, Australia, China, Pacific, Galapagos. Fossil, 460 sp. Trias—; Britain, France, United States, etc. *C. fusiforme* (lxix, 49).

Shell turreted, many-whorled, with indistinct varices; aperture small, with a tortuous canal in front; outer lip expanded; inner lip thickened; operculum horny, spiral.

Some of the species emit a bright green fluid when molested.

VERTAGUS, Klein. (*Rhinoclavis*, Swains. *Lampanella*, Mörch.) Canal strongly recurved, columella with an oblique median plication. *C. lineatus*, Lam. (lxix, 50).

CERITHIODERMA, Conrad. Acutely ovate, striate; labrum grooved and umbilicate; columella recurved inferiorly or subtruncate; aperture patulous, margin obtusely rounded inferiorly; beak very short, narrow, recurved. *C. prima*, Conr. (lxix, 51). Eocene; Alabama.

COLINA, H. and A. Adams. Shell elongated, whorls numerous, convex, nodulous, with revolving striae; aperture oval, prolonged in front into a short, recurved canal; columella simple, oblique; outer lip expanded and reflexed. The middle whorls are gibbous.

and the sculpture usually becomes obsolete on the last whorl. The few species inhabit deep water, sandy bottom, at the Philippines, China, etc. *C. macrostoma*, Hinds (Ixix, 52).

CERITHIELLA, Verrill, 1882. (Lovenella, Sars.) Shell subulate; whorls numerous, cancellated; aperture terminating in a short, distinct reflected canal. Norway, New England. *C. metula*, Lovén (Ixix, 53).

BITTIUM, Leach. (Cerithiolum, Tiberi. Platygyra, Mörch.) Shell elevated, with numerous granular whorls, and irregular varices; anterior canal short, not recurved; inner lip simple; outer lip not reflected, usually with an exterior rib. Operculum four-whorled. Animal: Operculigerous lobe with rudimentary expansions on the sides and furnished with a roundish, lanceolate cirrus. Numerous small northern species, low-water to 80 fathoms. *C. reticulatum*, Da Costa (Ixix, 54).

CERITHIOPSIS, Forbes and Hanley. Shell like Bittium; nuclear whorls sinistral. Operculum pointed, nucleus apical. Proboscis retractile. Northern. *C. rugulosus*, Ads. (Ixix, 55).

SEILA, A. Ad. Shell like Cerithiopsis, transversely lirate.

CERITHINELLA, Gemm. Turreted to cylindrical, not perforated; mouth quadrangular, with very short canal; growth-lines recurved under the sutures. *C. Italica*, Gemm. Jurassic.

DITRETUS, Piette, 1874. Turreted; mouth oval or rounded, with very short, entirely rounded canal; inner lip spread out, callous; outer lip thickened; whorls with longitudinal rows of tubercles. *C. rostellaria*, Buv. Jurassic.

VICARIA, d'Arch, 1854. Turreted; whorls spirally striated, with a row of tubercles below the suture; canal short, recurved; inner lip callously thickened; outer lip with a deep, broad, superior sinus. *C. Verneuli*, d'Arch. Eocene; East Indies.

FIBULA, Piette, 1857. Shell elongated, columella straight, with a rudimentary groove near the base; outer lip arched, slightly notched at the suture; base of the aperture forming a slight canal, or rounded and entire, depending upon the exact period of growth at which the animal perished. The species of this genus possess characters intermediate and approximating them to Turritella and to Cerithium. Fossil, 21 sp. Jurassic to Cretaceous; Europe, India. *F. undulosa*, Piette (Ixix, 56).

EUSTOMA, Piette, 1855. Shell in the young state resembling Cerithium; in the adult the margins of the aperture are much expanded and posteriorly united by an indistinct canal; canal elongated. Several species. Great Oolite; Ardennes.

CERITELLA, Morris and Lycett, 1850. (Costellifer, Meek. Tubifer, Piette.) Shell small, resembling Actæonina in form, the last volution being somewhat ventricose and largest, but terminating anteriorly with a short and slightly twisted canal. *C. acuta*, Morris and Lycett (Ixix, 57). Jurassic.

MESOSTOMA, Deshayes, 1864.

Distr.—Fossil, 4 sp. Eocene; Paris. *M. grata*, Dh.

Shell elongated, turreted, scalariform; aperture nearly circular, dilated, obliquely cut, terminating in front by a semicanal-iculated angle; columella slightly concave, cylindrical, obliquely truncated, lip simple, and slightly expanded.

EXELISSA, Piette, 1861.

Etym.—*Exelisso*, to unfold. *Syn.*—Kilvertia, Lycett, 1863.

Distr.—Fossil, 14 sp. Mid. Lias to Kimmeridge Clay; England and France. Cretaceous, 1 sp. (?); India. *E. formosa*, Lycett (lxix, 62).

Shell small, elongated, subcylindrical, somewhat pupiform, many-whorled, perpendicularly costated, tuberculated or spined; last whorl cylindrical, contracted at the base, with a tendency to separate from the axis; aperture orbicular, entire, the lips elevated, produced, and slightly thickened; columella solid.

Includes a large number of very characteristic transversely ribbed species. It is uncertain whether there was an anterior canal or not, and therefore the pertinence of the genus to this family remains doubtful.

FASTIGIELLA, Reeve.

Distr.—1 recent sp.; and an Eocene sp., Paris basin. *F. carinata*, Reeve (lxx, 64).

Shell elongated, turriculated, whorls rounded, with revolving ribs; aperture prolonged into a short, slightly twisted canal; axis rimate.

TRIFORIS, Deshayes.

Syn.—Tristoma, Blainv.

Distr.—100 sp. E. Indies, Polynesia, Australia, Panama, W. Indies, Mediterranean. Fossil. Eocene; Europe. *T. perversus*, Linn. (lxix, 58).

Shell sinistral, sculptured, granular; whorls numerous, terminating below in a small aperture, with tubular anterior canal; opposite this canal is sometimes a second one upon a varix, marking the position of a former aperture. Operculum orbicular, few-whorled.

Animal. Tentacles clavate at the tips, united at their bases by a sinuated veil.

INO, Hinds. (Inella, Bayle.) Shell cylindrically subulate, elongated, spire sharp-pointed. *T. corrugatus*, Hinds (lxix, 59).

SYCHAR, Hinds. Shell elongated, whorls rounded. *T. vitreus*, Hinds (lxix, 60).

MASTONIA, Hinds. Shell acuminate, swollen in the middle. *T. vulpinus*, Hinds (lxix, 61).

LÆOCOCHLIS, Dunker and Metzger. Shell turreted; whorls

numerous, cingulated; aperture ending in a twisted, short canal. Operculum very thin, indistinctly spiral, with excentric nucleus. *T. granosus*, Wood (lxx, 65).

POTAMIDES, Brongniart.

Etym.—*Potamos*, a river, and *ides*, patronymic termination. Fresh-water Cerites. *Syn.*—*Potomis*, Swains.

Distr.—50 sp. Tropical and subtropical. Fresh and brackish, streams and swamps. Fossil, numerous. Eocene—. *P. mamillatum*, Risso (lxix, 63). *P. ebeninum*, Brug. (lxx, 66).

Shell turriculated, whorls angulated and coronated; aperture prolonged in front into a nearly straight canal; outer lip thin, sinuous; epidermis thick, olive-brown. Operculum many-whorled.

BROTIA, H. Adams. Shell fusiform, spire elevated, whorls spinulose, the last subrostrate in front; aperture subovate, produced anteriorly. Operculum corneous, multispiral. Fluvatile. Siam. *P. pagodula*, Gould (lxx, 67). The type was described as a Melanian, but the operculum at once separates it from that genus.

TYMPANOTOMUS, Klein. Columella twisted; outer lip broadly sinuated anteriorly, and less distinctly so posteriorly. *P. fuscata*, Linn. (lxx, 68).

LAMPANIA, Gray. Shell turriculated, whorls numerous, without varices; sculpture not prominent; aperture truncate below; without canal; outer lip sinuous. *P. zonale*, Brug. (lxx, 69).

PYRAZUS, Montfort. (Terebralia, Swains.) Whorls with revolving striæ, not tuberculate; aperture with a short anterior canal; columellar callosity spiral, oblique; outer lip thickened, expanded, rounded anteriorly, and turning upwards to join the inner lip. *P. sulcatum*, Brug. (lxx, 70). *P. palustris* occurs in great abundance in the salt marshes of the Eastern Archipelago, and is assiduously collected by the natives, who roast them and suck the contents of the shell through an aperture made by breaking off the tip of the spire.

Dr. Brot has made the interesting discovery that the species of this group possess two columellar plicæ, and opposite to these, upon the surface of the outer wall of the shell, are teeth, occurring wherever an external varix has been formed. These do not approach the aperture, and are only discovered upon making a longitudinal section of the shell. They do not occur in the related subgenera, but their presence is mentioned by Deshayes in some of the fossil species of the Paris basin, and they are very characteristic of the fossil genus *Nerinaea*, which may thus connect *Cerithium* and *Pyramidella*.

TELESCOPIUM, Montfort. (Terebralia, Swains.) Shell pyramidal; columella with a prominent fold, more or less continuous towards the apex; and a second, less distinct, on the basal front

of the whorls. India, North Australia. *P. telescopium* (lxx, 71) is so abundant near Calcutta as to be used for burning into lime; great heaps of it are first exposed to the sun, to kill the animals. They have been brought alive to England. (BENSON.) In Borneo they are eaten by the natives.

CERITHIDEA, Swains. Shell turriculated, longitudinally ribbed; whorls numerous; summit of spire more or less decollated, aperture rounded, slightly slit anteriorly, outer lip expanded, thickened, broadly rounded below and usually produced into a beak crossing the sinus to the left. Eye-pedicels long and thick, connate with the tentacles nearly to their tips. Inhabit salt marshes, mangrove swamps, and the mouth of rivers; they are so commonly out of the water as to have been taken for land-shells. Mr. Adams noticed them in the fresh waters of the interior of Borneo, creeping on pontederia and sedges; they often suspend themselves by glutinous threads *Distr.*—India, Ceylon, Singapore, Borneo, Philippines, Port Essington. *P. decollatum*, Linn. (lxx, 72). *P. obtusum*, Lam. (lxx, 73).

PIRENELLA, Gray, 1847. Shell turriculated, whorls granulated, or with irregular ribs and varices; aperture rounded; anterior canal short; inner lip simple, outer lip thin, sinuous. *P. mamillatum*, Phil. There is a fossil species in the Laramie beds, U. S.

SANDBERGERIA, Bosquet, 1861. Proposed for a number of ovate species, from the tertiary, having a very broad, shallow, but slightly produced canaliculation in front. The operculum is said to be paucispiral, and if this be actually the case, the division may be maintained, otherwise the shells are not readily distinguishable from Cerithidea. *P. antecedens*, Stol.

ESCOFFIERIA, Fontannes, 1881. *P. Fischeri*, Font. Tertiary; France.

FAMILY MELANIIDÆ.

Shell spiral, turreted; with a thick, dark epidermis; aperture often channeled, or notched in front; outer lip acute; operculum horny, spiral. The spire is often extensively eroded by the acidity of the water in which the animals live.

Animal with a broad, non-retractile muzzle; tentacles distant, subulate; eyes on short stalks, united to the outer sides of the tentacles; foot broad and short, angulated in front; mantle-margin fringed; tongue long and linear, with a median, and three lateral series of hooked multicuspid teeth; gill composed of rigid, cylindrical plates. Often viviparous. Inhabiting fresh-water lakes and rivers throughout the warmer parts of the world (except North America).

The Melanians are fluviatile mollusks, closely related through Potamides, with the Cerithiidae. They possess the fringed mantle-margin characteristic of the latter family, and are thereby imme-

diately separable from the peculiarly North American group Streptomatidæ, which they much resemble in the characters of the shell. Mainly of Indo-Pacific, African and Polynesian distribution, they number several hundred existing species, besides a number of fossil forms commencing with the jurassic period.

PALUDOMUS, Swainson.

Etym.—*Palus*, a marsh, and *domus*, home.

Syn.—*Rivulina*, Lea.

Distr.—25 sp. Ceylon, India. *P. conicus*, Gray (lxx, 74).

Shell Paludiniform; columella callous, scarcely planulate. Operculum concentric, with spiral, sinistral, subcentral nucleus.

PHILOPOTAMIS, Layard. (*Heteropoma*, Benson.) Shell frequently globose, but spire exerted; columella callous, scarcely planulate. Operculum subspiral; nucleus basal, dextral, submarginal. *Distr.*—9 sp. Ceylon, Sumatra. *P. nigricans*, Reeve (lxx, 75).

TANALIA, Gray. (Ganga, Layard. *Serenia*, Benson.) Shell globose, neritiform; columella wide, planulate. Operculum lamellated, nucleus dextral, median, marginal. *Distr.*—7 sp. Ceylon. *P. loricata*, Reeve (lxx, 76).

STOMATODON, Benson. Shell globose, columella wide, base truncate and furnished with a prominent tooth. Operculum (?). *Distr.*—*P. Bensoni*, Brot. (lxx, 77). Southern India.

MELANIA, Lam.

Etym.—*Melania*, blackness (from *melas*).

Distr.—400 sp. So. Europe, India, Philippines, Pacific Islands.

Shell turreted, apex acute (unless eroded); whorls ornamented with striæ or spines; aperture oval, pointed above; outer lip sharp, sinuous. Operculum subspiral.

MELANELLA, Swainson. Shell ovoid, with elevated spire; aperture large, its base subproduced and rounded. Operculum paucispiral, nucleus subspiral. *M. glans*, von dem Busch (lxx, 78). Java. Includes *M. Hollandri*, Fer., and *M. parvula*, Schmidt; European species.

ACROSTOMA, Brot. Shell fusiform, subbiconic; aperture angulately produced at the base. Operculum (?). *M. Hügelii*, Phil. Java, India.

PACHYCHILUS, Lea. Shell turreted or subfusiform; aperture ovate, its base subproduced, peristome usually thickened. Operculum three- to four-whorled, with subcentral nucleus. Mexican, Central American. *M. lævissima*, Sowb. (lxx, 79).

AYLACOSTOMA, Spix. (*Aulacostoma*, Agassiz.) Whorls carinated or shouldered near the suture. South America. *M. scalaris*, Spix (lxx, 80).

SULCOSPIRA, Troschel. Shell ovately turreted, sulcate-striate;

aperture ovate, base subproduced. Operculum three- to four-whorled, nucleus subcentral, rarely subbasal. *M. sulcospira*, Mousson (lxx, 81). East Indies.

NIGRITELLA, Brot. Shell ovoid-turreted, smooth, but slightly granosely striate. Operculum subspiral, nucleus submarginal. *M. decollata*, Lam. (lxx, 82). Africa, Madagascar.

MELANOIDES, Olivier. Shell turreted, usually large, elevately striate and plicate, plicæ usually tuberculose. Operculum subtrispiral, nucleus excentric, sinistral. East Indies, Philippines. *M. asperata*. *M. variabilis*. *M. episcopalis*, Lea (lxx, 83).

MELANIA, H. and A. Adams. (Ellipstoma, Raf.) Shell usually subulate, whorls numerous. Operculum paucispiral, nucleus submarginal. *M. hastula* (lxx, 84). *M. Mindoroensis*. *M. acuminata*. East Indies, Polynesia.

STRIATELLA, Brot. Turreted, spirally more or less striate, sometimes longitudinally plicate, aperture rounded at the base, columella a little twisted. *M. corporosa*. *M. tuberculata* (lxx, 85). Java, Polynesia.

PLOTIA (Bolten), H. and A. Adams. Shell medium or small, spirally closely striate or lirate; whorls angulate and spiny above; corneous, strigate or punctate with red. Operculum subspiral, nucleus submarginal, basal. *M. spinulosa*. *M. bellicosa*, Hinds (lxx, 86).

PLOTIOPSIS, Brot. Shell like the preceding, but shortly tuberculose (not spinose) at the angle. Operculum subspiral, nucleus submarginal. *M. Balonnensis*, Conr. (lxx, 87).

TIARA (Bolten), H. and A. Adams. (Amarula, Sowb. Melas, Montf. Melacantha, Swainson. Paramelania, E. A. Smith.) Shell usually large, mostly smooth, rarely with elevated cingulæ, whorls angulated and spinose above. Operculum paucispiral, nucleus submarginal. *M. amarula*. *M. setosa*, Swains. (lxx, 88).

TIAROPSIS, Brot. Shell medium size, lirate or sulcate; whorls with a single row of nodules or short spines above; margin of the aperture sinuous. *M. Winteri*, Busch (lxx, 89).

TAREBIA, H. and A. Adams. Shell oblong or ovately turreted, granosely decussated; aperture-margin sinuous. Operculum paucispiral, nucleus submarginal. *M. Celebensis*, Quoy (lxx, 90).

SERMYLA, H. and A. Adams. Shell Tornatelliform, above longitudinally costate, below with revolving liræ; aperture-margin sinuous. Operculum paucispiral, nucleus submarginal. *M. tornatella*, Lea (lxx, 91).

ONCOMELANIA, Gredler. Shell rimate, turreted, strongly ribbed, ribs pellucid; aperture scarcely effuse below, small; peristome continuous or connected by a columellar callus, widely sublabiate, with an exterior varix. 1 sp. China. The operculum is of the normal form. The position of this shell is

somewhat doubtful; it may belong to the Rissoidæ. *M. Hupensis*, Gredler (lxx, 92).

PTYCHOSTYLUS, Sandberger.

Distr.—*P. harpæformis*, Dunker. Wealden, Europe,

Shell egg-shaped, with scalariform, sharp spire; whorls ribbed transversely; mouth small, acutely angular behind, somewhat wider and rounded in front; columella folded.

DORYSSA, H. and A. Adams.

Distr.—17 sp. Eastern South America. *D. brevior*, Troschel (lxxv, 93).

Shell turreted, longitudinally plicate, decussated by revolving sulcations; aperture effused at the base, right margin uncinately produced. Operculum spiral with sinistral subcentral nucleus (?).

CLAVIGER, Haldeman.

Syn.—*Vibex* (Oken), Gray.

Distr.—7 sp. Africa. *C. aurita*, Lam. (lxxi, 94).

Shell turreted, with revolving carinæ or tubercles; aperture subproduced at the base, subcanaliculate, outer margin sinuous, two to four plicæ within. Operculum paucispiral; nucleus basal, submarginal, sinistral.

TIPHOBIA, E. A. Smith.

Distr.—Lake Tanganyika, Africa. *T. Horei*, Smith (lxxi, 95).

Shell subturbinate, spire depressed; whorls flattened above, angulated and spinose; axis and aperture prolonged into a channeled beak.

Similar in form to the American genus *Io*. The operculum is unknown. It has been referred temporarily to the family Melaniidæ, but is quite as closely allied, I think, to the fresh-water division of the Cerithiidæ, and especially to the Siamese genus *Brotia*.

HEMISINUS, Swainson.

Syn.—*Basistoma*, Lea. *Tania*, Gray.

Distr.—36 sp. So. and Central America, W. Indies, Seychelles, Australia. *H. lineolatus*, Wood (lxxi, 96).

Aperture canaliculated at the base, columella not callous. Operculum paucispiral; nucleus basal, sinistral, marginal or submarginal.

VERENA, H. and A. Adams. Shell turbinated, shouldered and coronated, spirally striate; aperture subtruncated anteriorly, forming a short, wide canal. South America. *H. crenocarina*, Moric. (lxxi, 97).

MELANOPSIS, Ferussac.

Syn.—*Bulliopsis*, Conrad. *Coptostylus* and *Campylostylus*, Sandb.

Distr.—41 sp. Mediterranean region of Europe, Asia and Africa, New Caledonia, New Zealand. Fossil, 25 sp. Eocene—; Europe, United States. *M. prærosa*, Linn. (lxxi, 99).

Aperture excised-canaliculate at the base, a thick, tubercular parietal callus above. Operculum subspiral or paucispiral, nucleus sinistral, marginal or submarginal.

CANTHIDOMUS, Swainson. Spire generally short; whorls coronated or longitudinally ribbed, last whorl anteriorly obtuse. *M. costata*, Fer. (lxxi, 98).

LYRCEA, H. and A. Adams. Shell oval-fusiform, whorls grooved; inner lip with a large posterior callus; columella subtruncate in front; aperture posteriorly canaliculated. *M. Dufourii*, Graells.

MELANOPTYCHA, Neumayr, 1880. Columella plicate. Tertiary; Austria. *M. Bittneri*, Neumayr (lxxi, 100).

SMENDOVIA, Tournouër, 1882.

Distr.—*S. Thomasi*, Tourn. Tertiary; Algiers.

Shell large, fragile, fusiform; spire acute; last whorl gibbous, longitudinally plicate; columella callous (callus tumid, not produced behind), almost straight, anteriorly somewhat produced into a recurved canal, which is scarcely margined.

STOMATOPSIS, Stache.

Distr.—*S. crassicostata*, Stache. Cosinaschichten, Dalmatia.

Shell thick, long ovate, spire sharp, scalariform, with sharp, fold-like transverse ribs, affecting the sutural line; mouth rounded or oval, somewhat angular, with thickened lip.

FAUNUS, Montfort.

Syn.—Pirena, Lam. Faunopsis, Gill (young shell).

Distr.—4 sp. Ceylon, Philippines, Western Polynesia. *F. atra*, Linn. (lxxi, 1).

Shell subulate, smooth; aperture profoundly excised-emarginate at the base, sinuate above; columellar lip callous. Operculum (?).

The species of this genus, which differs from Melanopsis in the length of the spire, and in the sinuated, broadly-expanded outer lip, inhabit the beds of tropical rivers and rivulets, where they may be seen crawling on the soft mud at the bottom, feeding, apparently, on decayed vegetable matter.

MELANATRIA, Bowd.

Distr.—5 sp. Madagascar. *M. fluminea*, Gmel. (lxxi, 2).

Shell turreted, smooth or costate, sometimes spinose; aperture more or less sinuous at the base and above. Operculum spiral; nucleus sinistral, subcentral.

PIRENOPSIS, Brot. Solid, turreted, longitudinally ribbed, spirally

striate, not spinose; aperture sinuate above and below, outer margin widely arcuately protracted. Operculum acutely ovate, subspiral, nucleus basal, submarginal. *M. costata*, Quoy.

FAMILY STREPOMATIDÆ.

Shell turreted, or ovate, smooth or variously sculptured, covered with an olivaceous epidermis; aperture angulated or channeled in front. Operculum subspiral.

Animal with plain (not fringed) mantle-margin. Oviparous. Dentition (xl, 27).

Except two or three West Indian species, the distribution of the family, numbering about 500 species, is confined to the United States, and principally to the upper waters of the streams taking their rise in the mountains of the middle southern region.

The oriental Melaniidæ have fringed mantle-margins, and the shells have generally a broadly rounded aperture, not produced at the base.

Io, Lea.

Syn.—*Melafusus*, Swains.

Distr.—5 sp. Middle and East Tennessee, W. Virginia. *I. spinosa*, Lea (lxxi, 3, 4).

Shell fusiform, usually nodulous, with elevated spire; aperture produced anteriorly into a narrow, twisted canal; columella smooth, concave.

ANGITREMA, Haldeman.

Syn.—*Potadoma* (part) Swains. *Glotella*, Gray. *Juga* (sp.), Chenu. *Meseschiza*, Lea.

Distr.—12 sp. Indiana, Tennessee, Northern Alabama. *A. Duttoniana*, Lea (lxxi, 5).

Shell spinous; aperture subrhomboidal, with an anterior short canal; columella with a callous deposit anteriorly and posteriorly. *Meseschiza* is founded upon young specimens of *A. armigera*, Say, in which the growth of the outer lip has been interfered with at its periphery, causing a seam and slight sinus; it is undoubtedly monstrous.

LITHASIA, Haldeman. (*Megara* [sp.], H. and A. Adams.) Shell ovately fusiform or oval, small, smooth; aperture not so distinctly channeled in front as in the typical *Angitrema*; columella with anterior and posterior callous deposit. 14 sp. Ohio River, Indiana, Kentucky, Tennessee, Alabama. *A. dilatata*, Lea (lxxi, 6).

STREPHOBASIS, Lea. (*Megara* [sp.], H. and A. Adams.) Shell like *Lithasia*, with retrorse canal. 9 sp. Tennessee, Alabama. *A. curta*, Hald. (lxxi, 7).

PLEUROCERA, Rafinesque. (*Ceriphasia*, Swainson. *Telescopella*, Gray. *Trypanostoma*, Lea. *Megara* and *Elimia* [sp.], H. and A.

Adams. *Strepoma*, Raf.) Shell generally lengthened conical, with elevated spire; aperture moderate, produced into a short spout or canal in front; columella not callously thickened. *Distr.*—84 sp. Ohio, Tennessee and Alabama Rivers and their tributaries. *P. canaliculata*, Say (lxxi, 8).

GONIOBASIS, Lea.

Syn.—*Melasma*, Juga, Megara (sp.), Elimia, H. and A. Adams.

Distr.—274 sp. United States, east of the Mississippi River, California and Oregon. *G. impressa*, Lea (lxxi, 9). *G. Boykiniana*, Lea (lxxi, 10). *G. Virginica*, Say (lxxi, 11). The genus does not occur recent in the elevated region west of the Mississippi. Fossil, Laramie beds—; Western U. S.

Shell heavy, ovate or elongated; aperture somewhat angulated in front, but neither notched or canaliculate.

EURYCÆLON, Lea. Shell obovate, heavy, nodosely angled; aperture large, ear-shaped; columella oval, subtruncate. 10 sp. E. Tennessee, N. Alabama. *G. Anthonyi*, Budd (lxxi, 12).

PYRGULIFERA, Meek.

Distr.—Cretaceous; Wyoming T., U. S. *P. humerosa*, Meek (lxxi, 13).

Spire produced; whorls shouldered and nodular; aperture subovate, faintly sinuous, a little produced, but not notched or distinctly angular below; columellar lip a little callous below, thickened throughout. Very closely allied to the Melanian genus *Tiara*, Bolten. Dr. C. A. White considers *Paramelania*, E. A. Smith (= *Tiara*), synonymous; it includes three species living in the African lake Tanganyika.

CASSIOPELLA, White, 1878.

Distr.—*C. turricula*, White. Fossil, Laramie beds; Western U. S.

Shell turriculate, the whorls angulated in the middle. Differs from *Goniobasis* in being umbilicated.

SCHIZOSTOMA, Lea.

Syn.—*Schizocœilus*, Lea. *Gyrotoma*, Shuttleworth. *Melasma*, Anthony. *Apella*, Mighels.

Distr.—26 sp. Coosa River, Alabama. *S. babylonicum*, Lea (lxxi, 14–16).

Shell conical or fusiform; aperture large, ovate, obtusely angled below; outer lip with a posterior, sutural sinus or fissure; columella smooth, incurved.

ANCULOSA, Say.

Syn.—*Anculotus*, Say. *Ancylotus*, Herm. *Leptoxis* (Raf?), Hald.

Distr.—26 sp. Ohio River and southwards to Alabama; Southern Atlantic States. *A. tæniata*, Conr. (lxxi, 17).

Shell oval, heavy, with very short spire; aperture entire and rounded in front; columella callously thickened above.

MUDALIA, Hald. (Nitocris, H. and A. Ad.) Shell thinner, inflated. Potomac and Susquehanna, Kanawha, and Upper Ohio rivers. The distribution is thus more northern than that of the type group. *A. dissimilis*, Say (lxxi, 19).

FAMILY RISSEOELLIDÆ.

Shell small, thin, transparent, spire elevated, aperture entire, rounded or slightly sinuous anteriorly. Operculum corneous, concentric.

Animal with bilobate rostrum, eyes sessile on the head back of the tentacles.

These curious little animals are found adhering to floating seaweeds, in pools between tide-marks; their eyes are situated so far behind the tentacles that the transparency of the shell seems to be essential to the vision of the animal. The bilobate mouth and absence of retractile proboscis indicate them to be vegetable feeders. In some respects closely allied to Litiopa.

RISSEOELLA, Gray.

Syn.—Jeffreysia, Alder.

Distr.—6 sp. Britain. On sea-weed, near low-water. (ALDER.) There are eight other species in the Japanese seas. *R. diaphana*, Forbes and Hanley (lxxi, 20, 21).

Shell minute, translucent. Operculum semilunar, imbricated, with a projection from the straight, inner side. Head elongated, deeply cleft, and produced into two tentacular processes; mouth armed with denticulated jaws, and a spinous tongue; tentacles linear, eyes far behind, prominent, only visible through the shell; foot bilobed in front.

FAIRBANKIA, Blanford, 1868.

Distr.—*F. Bombayana*, Blf. Estuary; Bombay Harbor.

Shell imperforate, turreted, with a brown epidermis; aperture suboval, rounded in front; peristome slightly dilated, external margin acute, but exteriorly with variciform thickening. Operculum corneous, subannular with an interior long, transverse rib.

Animal with long filiform tentacles, and eyes sessile at their bases; proboscis elongated; foot wide and sinuated in front, rounded behind.

Combines the epidermis, and to a great extent the animal of Hydrobia with the peristome of Rissoa; the operculum approaches that of Rissoella. It differs from Barleeia in its

epidermis, exteriorly thickened lip, horny operculum, and want of long pointed apophysis.

IRAVADIA, Blanford, 1867.

Distr.—*S. ornata*, Blf. Brackish water, India.

The shell has the general form of a Rissoa, but the apex is often obtuse, the whorls are spirally ribbed, covered with an epidermis; aperture ovate, with continuous margins, anteriorly slightly effuse; outer lip with an external varix. Operculum and animal unknown.

HYALA, H. and A. Adams.

Distr.—European. *H. vitrea*, Forbes and Hanley (lxxi, 22).

Shell thin, hyaline, elevated conic; aperture oval, slightly emarginated anteriorly; outer lip thin, simple. Operculum thin, corneous, simple, subspiral. The tentacles of the animal have bristle-like summits.

TATEA, Woods.

Distr.—Tasmania. *T. Huonensis*, Woods (lxxii, 30).

Shell elongate-pyramidal. Operculum calcareous, with a vertical, submarginal claw. Animal with truncate foot, and long tentacles.

The operculum has the form of that of Rissoella, but differs in being calcareous.

FAMILY RISSOIDÆ.

Shell small, spiral, turreted or depressed, often more or less umbilicated; aperture more or less rounded, never truly channeled in front; peritreme continuous.

Tentacles elongated, with the eyes at their outer bases. Verge (male organ) exserted, situated on the back at a considerable distance behind the right tentacle. Gills both pallial; the right or principal one usually rather short and broad, and composed of few laminae, which are much broader than high. Foot oblong, punctate before, rounded or pointed behind. Operculigerous lobe well developed. Operculum horny or partly shelly, spiral or concentric. Lingual teeth, 3·1·3; living in fresh, brackish or sea-water, sometimes amphibious. Distribution mundane.

Stoliczka indicates two principal groups in this family: the first including the marine genera, with thick, solid shells, and, as a rule, with the labrum externally thickened; the other the brackish and fresh-water or amphibious genera, the shells of which are usually thin, smooth, with an olivaceous epidermis, the labrum not externally thickened. The animals of all the Rissoidæ are very similarly formed, but those living in fresh or brackish waters have generally no appendages on the posterior portion of the foot, and the operculigerous lobes are less developed than in the marine forms. The eye-peduncles are generally

united with the tentacles, but it seems that their length increases, the more the animal is accustomed to an amphibious life. Thus some of the species have the eyes placed near the basis of the tentacles, others in the middle, and still others at the tips of the same. The differences are very gradual, which makes it impossible to regard them as of any important generic value. The length of the rostrum also appears to increase in some forms, corresponding with their more amphibious habits; and also, while the foot itself often lengthens, its disk at the same time becomes smaller.

SUBFAMILY BYTHININÆ.

Shell small, conical; peritreme simple or thickened. Operculum calcareous, concentric. Fresh water.

BYTHINIA, Gray.

Syn.—Elona, Moquin-Tandon. Grayana, Betta.

Distr.—50 sp. Europe, Southern Asia, Australia, etc. Fossil. Wealden and Tertiary. *B. Leachii*, Shepp. (lxxii, 29).

Shell oval, turbinated, thin, invested with a thin epidermis; peritreme continuous.

The female is oviparous and deposits her eggs in a band, attached to stones or the stems of aquatic plants; with her mouth she clears the surface upon which she intends to deposit the ova. The young are hatched in three or four weeks, attaining full growth in the second year.

TYLOPOMA, Brusina, 1882. Shell form of *Tulotoma* (Paludidinae), but smaller. Operculum calcareous. *B. avellana*, Neum.

GABBIA, Tryon. Shell turbinately globose, whorls well rounded; peritreme continuous; axis perforate. Operculum, nucleus subspiral, afterwards concentric, calcareous. *Distr.*—*B. australis*, Tryon (lxxi, 23). Fresh water, Australia. It is possibly synonymous with *Bythinia*, from which it only differs slightly in its operculum.

STENOTHYRA, Benson.

Syn.—*Nematura*, Benson.

Distr.—Fresh water, India, East Indies. Fossil. Eocene; Paris basin. *S. deltae*, Benson (lxxii, 31).

Shell ovate, smooth, imperforate; aperture rounded, contracted. Operculum testaceous, annular, ovate, thick, nucleus subcentral, margin grooved.

The species are found either attached to the under surface of floating leaves, or crawling out of the water on the muddy margins of ponds, leaving, as they progress, slender tracks behind them.

NEMATURELLA, Sandberger. Like *Stenothyra*, but with longer spire; lip flexuous, forming a slight sinus above. Operculum unknown. Pliocene; Europe. 4 sp.

EUCHILUS, Sandberger. Shell small, elongate-conoidal, smooth, rimate; outer lip expanded. Operculum concentric, calcareous. Tertiary; Europe. 9 sp. *E. Deschiensianum*, Sandb. (lxxiii, 4).

SUBFAMILY SKENEINÆ.

Shell depressed, nearly discoidal. Operculum multispiral, corneous. Marine.

SKENEA, Fleming.

Etym.—Named after Dr. Skene, of Aberdeen, a contemporary of Linnæus.

Syn.—Delphinoidea, Brown.

Distr.—Northern seas, Norway, and Britain. *S. cornuella*, Straits of Korea (Adams). *S. planorbis*, Fabr. (lxxii, 32, 33).

Shell minute orbicular, depressed, few-whorled; peristome continuous, entire, round. Operculum multispiral. Animal like Rissoa, foot rounded behind. Found under stones at low-water, and amongst the roots of *Corallina officinalis*.

SUBFAMILY RISSOININÆ.

Shell ovate or turreted; with a thick, corneous, or calcareous paucispiral operculum provided with an internal process (articulated). Size small. Marine.

The genera are well characterized, not only by the form of the operculum, but especially by the form of their aperture, which is anteriorly effuse or truncate; the outer lip being peculiarly produced either anteriorly or near the middle.

RISSOINA, d'Orbigny.

Distr.—About 100 sp. World-wide. *R. Catesbyana*, d'Orb. (lxxi, 24, 25).

Shell turreted, whorls numerous, ribbed or cancellated; aperture semilunar, lip slightly thickened within, somewhat expanded, faintly channeled anteriorly. Operculum corneous, thick, semilunar, paucispiral, with an interior process.

ISSELIELLA, Nevill. (Isselia, Semper, preoccupied.) The embryonal shell is sinistral, and von Martens thinks that it should therefore be removed to the neighborhood of Cerithiopsis. The shells do not otherwise differ essentially from Rissoa, and I agree with Dr. Weinkauff that, while the animal and operculum remain unknown, it is better to allow the species to remain in Rissoina. *R. mirabilis*, Dunker, is the type, and there are several other Polynesian species.

ZEBINA, H. and A. Adams. Shell white, solid, opaque, polished, smooth or partly striate; outer lip rather thick, with one or more internal anterior tubercles. *R. tridentata* (lxxi, 26).

ZEBINELLA, Murch. Shell costellate, spirally striate. *R. elegantissima*, d'Orb. (lxxi, 27).

PHOSINELLA, Mörch. Shell reticulated, aperture profoundly sinuated. Operculum with styliiform apophysis, denticulate posteriorly. *R. Sagraiana*, d'Orb. (lxxii, 37).

SCHWARTZIELLA, Nevill. Aperture without basal emargination. *R. coronata* (lxxii, 34).

EATONIELLA, Dall. (*Eatonia*, E. A. Smith.) Shell rissoïd, smooth; aperture subcircular, peristome simple, continuous, the labral margin not thickened. Operculum paucispiral, nucleus near the base, with an interior rib or ossicle. Differs from *Rissoina* in the absence of the basal, faint channel of the aperture and thin lip. *Distr.*—3 sp. Kerguelen's Island. *R. Kerguelensis*, Smith (lxxii, 35, 36).

MICROSTELMA, A. Ad., 1863. Shell turreted-ovate, rimate; spire conic; whorls longitudinally plicate; aperture oblong, produced anteriorly, subcanaliculate; inner lip thickened, outer lip simple. *Distr.*—*R. dædala*, A. Ad. Japan.

BARLEEIA, Clark.

Etym.—Named in honor of G. Barlee.

Distr.—Europe, W. America, etc. *B. rubra*, Ads. (lxxii, 38).

Shell conically turbinated; whorls rounded, smooth or slightly striated; aperture oval, entire, rounded in front; margin sharp. Operculum calcareous, subangular, with an internal rib-like process.

Operculigerous lobe simple; foot slightly emarginate posteriorly. The tentacles in this genus are short, broad, rounded at the tips and not setaceous; the eyes are large, on inflations at the outer bases of the tentacles; the rostrum is simple and not cloven; the foot is emarginate behind, and the operculum lobe is simple. The operculum is subannular as in *Rissoella*, and is furnished with a similar internal appendage; *Rissoina* has a similar appendage, but the operculum in that genus is paucispiral.

BACULA, H. and Adams, 1863.

Distr.—*B. striolata*, H. and A. Adams. China Sea.

Shell resembling *Eulima*, but without enamel; whorls spirally striated, inner lip thickened, as in the next genus, outer lip without a varix, produced either in the middle or somewhat anteriorly. The classification of *Bacula* in this place is only provisional.

KEILOSTOMA, Desh., 1848.

Syn.—*Paryphostoma*, Bayan., 1873.

Distr.—7 Cret. and 6 Eocene sp. Europe, India. *K. eximia*, Desh. (lxxii, 39).

Elongate, turriculated, frequently nearly smooth, aperture ovate, oblique, entire, narrow, subcanaliculate behind, truncate, subeffuse anteriorly, smooth within; both lips thickened, the

outer one laterally produced, the inner wide, callous; columella solid.

SUBFAMILY *RISSOINÆ*.

Shell ovate or elongated. Operculum paucispiral, not provided with a process. Foot of animal without lateral processes. Size small. Marine.

RISSOA, Frémenville.

Named after the French zoologist, Risso.

Syn.—Rissostomia, Sars.

Distr.—About 75 sp. Universally distributed, but most abundant in the north temperate zone. *R. costulata*, Risso (lxxi, 28).

Shell minute, white or horny; conical, pointed, many-whorled; smooth, ribbed, or cancellated; aperture rounded; peristome entire, continuous; outer lip slightly expanded and thickened; operculum subspiral.

The animal has long, slender tentacles, with eyes on small prominences near their outer bases; the foot is pointed behind; the operculigerous lobe has a wing-like process and a filament (cirrus) on each side. Lingual teeth single, subquadrate, hooked, dentated; uncini 3; 1 dentated, 2, 3, claw-shaped. They range from high-water to 100 fathoms, but abound most in shallow water, near shore, on beds of fucus and zostera.

Rissoa is active and bold, floats like its congeners, and spins a byssal thread instantaneously on being detached from a crawling position. The incessant play of the cilia that fringe the tentacles is very striking; it appears to be caused by the action of a double row of muscles in each tentacle, arranged in the form of a siphon, which is perceptible through the transparency of the integument. The pallial filaments probably serve the purpose of supplementary tentacles to warn the animal of impending danger.

MANZONIA, Brusina. Peristome duplicate. There are 8 European species.

ANABATHRON, Frauenfeld. Shell very small, thick, oblong, angulate, scalariform, imperforate, smooth; aperture rounded, peristome continuous. Operculum corneous. Australia. *R. contabulata*, Frauenf. (lxxii, 40).

PLAGIOSTYLA, Fischer. Shell transparent, apex papillary, last whorl descending, aperture semilunar, pillar-lip oblique, rectilinear. Europe.

ZIPPORA, Leach. (Acme, H. and A. Adams.) Shell subcylindrical, smooth or longitudinally ribbed; margin of aperture reflected. *R. Moutonii*, Dupuy (lxxii, 41).

PTEROSTOMA, Deshayes, 1864. Shell elongated, turriculated; peristome continuous, circular, very dilated and margined; colu-

mella very broad, expanded, and continuous with the peristome. *P. tuba*, Desh. (lxxii, 42). Eocene; Grignon, Paris.

SETIA, H. and A. Adams. Shell thin, oval-oblong or subconic; whorls few, ventricose, spotted; spire short, apex obtuse; aperture suborbicular. Animal with pilose tentacles. *R. pulcherrima*, Jeffreys (lxxii, 43).

CERATIA, H. and A. Adams. Shell subcylindrical, spirally striated, white, thin, subpellucid; whorls rounded, summit of spire obtuse; aperture suboval; peristome continuous, the outer lip thin and sharp. Animal with flattened, mostly short and claviform tentacles; foot bifurcate behind. *R. proxima*, Alder (lxxii, 44).

CINGULA, Fleming. Shell thin, elongated, smooth or spirally striate, spotted or banded; aperture pyriform or oval; outer lip sharp, with an external varix. *R. cingillus*, Montf. (lxxii, 45).

ONOA, H. and A. Adams. Shell elongated; whorls numerous, rounded, spirally striate; aperture oval; peristome continuous, thick, simple or slightly reflected. *R. striata*, Mont. (lxxii, 46).

ALVANIA, Risso. Shell oval, turbiniform; spire short, apex sharp; whorls rounded, usually cancellated; aperture subcircular, crenulated within; outer lip with a marginal exterior varix. *R. abyssicola*, Forbes (lxxii, 47).

SABANÆA (Leach), Frauenfeld. Shell thick, stout, smooth. Australia, Europe. *R. flammea*, Frauenf. (lxxii, 48).

CORENA, A. Ad. Shell elately turbinate, rimate, apex obtuse; aperture circular, with continuous peristome; inner lip with a thin callous expansion, and acute posterior tubercle; outer lip with duplicated margin, well-reflected. *Distr.*—1 sp. Gulf of Suez.

HEMISTOMIA, Crosse. Shell subimperfected, elongated, thin; spire long, summit obtuse, suture well-marked; aperture obliquely semilunar; peristome simple, continuous, almost detached; columellar margin very oblique, thickened; basal margin widely rounded. Operculum unknown. New Caledonia. *R. Caledonica*, Crosse (lxxii, 49).

AMPHITHALAMUS, Carpenter, 1865. Shell rissoid, with a large nucleus; inner lip produced, outer lip joining it subposteriorly, suddenly contracted in the adult. Several minute species. California, Japan. *R. inclusa*, Carp.

FENELLA, A. Ad., 1860. Has the pupoid form of Rissoa, with longitudinal and transverse ribs; the outer lip without a varix. May perhaps belong to Pyramidellidæ, with which the animal nearly corresponds. *R. pupoides*, A. Ad. Japan.

DIASTOMA, Desh., 1848. Shell turreted, whorls with numerous transverse ribs, and with a few intermediate varices. Inner margin of the aperture partially detached from the previous whorl; the aperture itself is strongly contracted posteriorly.

As yet only known fossil in tertiary deposits. *R. variculosa*, Desh. (lxxii, 50).

NEVILLIA, H. Adams.

Dedicated to Mr. Geoffrey Nevill, an Anglo-Indian conchologist.

Distr.—2 sp. Mauritius, Isle of Bourbon. *N. picta*, H. Adams (lxxi, 52).

Shell imperforate, acutely ovate; whorls convex, spirally lirate, longitudinally striate; aperture oval; columella callous, toothed; lip acute, smooth within, varicose outside.

This genus has much the appearance of a minute species of *Craspedotus*, but there is no indication of nacre within the aperture, and the tooth on the columella is more like that of *Rissoa monodonta*; in form and sculpture *Nevillia* approaches *Alvania*.

PUTILLA, A. Ad., 1867.

Distr.—*P. lucida*, A. Ad. (lxxii, 51). Japan.

Shell turbinately conoidal, solid, smooth, rimate; aperture suborbicular; lip thickened, subeffuse in front, scarcely expanded. Family relationship obscure.

SUBFAMILY HYDROBIINÆ.

Shell very small, or of moderate size, never exceeding two-fifths of an inch in length, globose, ovate, or elongated, generally umbilicated or rimate, and covered with a periostraca for the most part of an olive-color; whorls moderately numerous (4–8), smooth, or, rarely, ribbed or carinated, never cancellated; aperture more or less ovate or rounded, rarely subacute or effuse anteriorly; peritreme continuous; outer lip usually simple and acute. Operculum paucispiral, corneous. Tentacles, verge and gills as in the diagnosis of the family (p. 259). Foot without lateral sinuses, truncate and auricled in front, and generally rounded behind; operculigerous lobe destitute of cirri. Station, in fresh and brackish water.

Like all of the Rissoidæ these little animals are strictly herbivorous. Moquin-Tandon remarks that they have, connected with the stomach, a cartilaginous stylet like that occurring in certain bivalves. Something like this stylet Stimpson has observed also in our American Melanians.

LITTORINELLA, Braun.

Syn.—*Paludinella*, Lovén (not Pfeiffer). *Littorinidea*, Eyd. and Soul.

Distr.—World-wide, brackish or sea-water, in sheltered positions. *L. minuta*, Totten (lxxii, 53).

Shell ovate or elongated, thin, smooth, perforate; whorls ventricose; apex obtuse; aperture rather broadly oval; inner lip not thickened. Operculum corneous.

In *L. minuta* the rostrum is rather long, the tentacles very slightly tapering, blunt at the end, foot rounded behind.

HYDROBIA, Hartmann.

Syn.—Paludinella, Lovén. Peringia, Paladilhe.

Distr.—World-wide, brackish water. *H. ulvæ*, Pennant (lxxii, 54).

Shell ovate or elongated, smooth, subperforate; spire conic; whorls flat; apex acute; aperture ovate; inner lip not thickened. Operculum corneous.

Rostrum rather long, tentacles somewhat tapering, but blunt at the extremity. Foot somewhat pointed behind.

EMMERICIA, Brusina.

Distr.—Living, 2 sp. Adriatic Region. *E. patula*, Brum.

Shell small, conoidal, rimate, smooth, shining, spire elevated; aperture patulous; peristome subcontinuous, inner lip adnate, the outer lip sinuate, wide, reflected. Operculum corneous, ovate, paucispiral, nucleus excentric.

TOURNOERIA, Brusina. Peristome inferiorly evased, simple. 1 recent, several tertiary species. Europe.

STALIOLA, Brusina, 1870. Peristome with a strong exterior marginal rib. Tertiary; Europe. 1 recent sp.

NYSTIA, Tournouer, 1869. (Forbesia, Nyst.) Aperture oblique, exteriorly swollen, spire truncate. Tertiary; Europe. *E. microstoma*, Desh.

BITHYNELLA, Moquin-Tandon.

Syn.—Leachia, Risso. Subulina, Troschel. Paludinella, Frauentfeld. Microna, Ziegler. Thermhydrobia, Paulucci. Frauenfeldia, Clessin.

Distr.—Fresh water, Europe, America, including California. *B. viridis*, Moquin-Tandon (lxxii, 55, 56).

Shell elongated-ovate, usually somewhat pupiform, imperforate, or simply rimate; apex obtuse; aperture oval or rounded; peristome continuous, outer lip slightly thickened. Operculum corneous, nucleus moderately large, not very close to the basal margin.

Tentacles tapering, blunt at the tip; foot rather narrow, rounded behind; verge bifid.

STIMPSONIA, Clessin. Proposed for the North American species, which differ from the European type in dentition.

VITRELLA, Clessin. (Bythiospeum, Bourg., 1882.) Shell small, thin, without sculpture; peristome continuous, sharp. Operculum paucispiral. Animal blind. Inhabits caves and streams in Europe. 15 sp. *B. pellucida*, Clessin (lxxii, 57).

MOITESSIERIA, Bourg. Shell inoperculate(?), diaphanous, crystalline, very fragile, microscopic, cylindrical, elongated; form of

Acicula, but malleated. 6 sp. France. *A. Simoniana*, Charp. (lxxv, 35). Is perhaps terrestrial.

LHOTELLERIA, Bourg. (*Locardia*, Folin.) Shell elongate-conical, apex obtuse, whorls rather convex, with impressed sutures; aperture dilated below, columellar margin oblique. *L. apocrypha*, Folin (lxxv, 36). France.

PAULIA, Bourg., 1882. 2 sp. France. *B. Berenguieri*, Bourg.

BELGRANDIA, Bourg. (*Stalion*, Brusina.) Like *Hydrobia*, but smaller, with longitudinal swellings upon the body-whorl, fainter or obsolete on those of the spire. Operculum spiral. 22 sp. Tertiary to recent. Southern Europe. *B. gibba*, Drap. (lxxii, 58).

MICROPYRGUS, Meek. Shell very small, subcylindrical, imperforate, obtuse at the apex; body-volution small, or less than half the entire length; aperture rhombic-oval, very narrowly rounded, and more or less effuse; peristome apparently not continuous; outer lip thin, simple, most prominent below the middle. Laramie beds, Dakotah. *B. minutulus*, Meek (lxxiii, 3).

PALUDESTINA, d'Orb. (*Eupaludestrina*, *Thalassobia*, *Pseudopaludinella*, Bourg.) Shell conic, more or less elongated, smooth, imperforate or nearly so, apex acute; aperture ovate; peristome continuous, outer lip acute; inner lip not thickened. Operculum corneous. Scarcely distinguishable from *Hydrobia*, except by its habitat. *Distr.*—Fresh water, West Indies, South America. *B. piscium*, d'Orb. (lxxii, 62).

ALBERTISIA, Issel.

Distr.—*A. punica*, Issel (lxxv, 37). Tunis.

Shell very small, cylindrical, with sutural costæ, apex obtuse; peristome continuous, reflected. Operculum unknown. May be an inoperculate shell.

MOHRENSTERNIA, Stoliczka.

Distr.—Fossil in brackish or fresh-water deposits. Eastern Europe. *M. angulata*, Esch. (lxxii, 59).

Shell turriculated, thin, semipellucid; whorls frequently transversely costulate; columella fissured at the base; aperture subovate, angulated behind, rounded in front; margin very little dilated; outer lip simple, scarcely varicose. Operculum unknown.

This, as well as the succeeding group, may be classed here temporarily, although they appear to have been aberrant members of the family, at least, if not entirely distinct.

POTAMACLIS, Sandberger.

Distr.—2 sp. Oligocene; Europe. *P. turritissima*, Forbes (lxxii, 60, 61).

Shell very long, with numerous slowly-enlarging, convex whorls; outer lip with a short sinus above. Operculum unknown.

TRICULA, Benson.

Distr.—1 sp. Fresh water, India. *T. Montana* (lxxii, 63) inhabits the river Kamaan, in India.

Shell elongated, smooth, subperforate; aperture ovate, rather narrow; inner lip thickened. Operculum corneous, nucleus very small, close to the base.

The animal has an elongated proboscis and filiform tentacles, with the eyes at their outer bases; in its thickened inner lip, the shell somewhat resembles *Paludomus*, but it is distinguished by its elongated spire and truncated apex.

PACHYDROBIA, Crosse and Fischer. Shell imperforate, oblong-ovate, rather thick; spire moderate, with impressed suture; aperture semicircular; peristome sinuous, continuous, thickened. Operculum subovate, thin, corneous, paucispiral. 2 sp. Fresh water, Siam, Cambodia. *T. paradoxa*, Cr. and F. (lxxii, 64).

PYRGULA, Christofori and Jan.

Syn.—Pyrgiscus, Herrmansen.

Distr.—Mountain streams, Europe, West Indies, South America. *P. helvetica*, Mich. (lxxii, 65).

Shell elongated, turreted, imperforate, four whorls, carinated; aperture oval, effuse anteriorly, outer lip not thickened. Operculum corneous, with projections on the outer margin corresponding to the concavities of the carinæ of the shell.

Foot narrow; obtuse, subbilobate in front, somewhat pointed behind, tentacles slender.

DIANA, Clessin. First whorls very small, last three nearly of equal size. *P. Thiesseana*, Clessin (lxxii, 66).

PALADILHIA, Bourg.

Distr.—7 sp. Europe. *P. pleurotoma*, Bourg. (lxxii, 67).

Shell minute, turreted, smooth; aperture expanded, peristome continuous, sinuous above and below; axis perforated.

Rivers of France. Only dead shells have been collected, so that the animal and operculum are unknown. The systematic position of the genus is doubtful. The Pleurotomoid sinus of the aperture is its remarkable feature.

LARTETIA, Bourg.

Named after the paleontologist, Edward Lartet.

Syn.—Micromelania, Brusina. Goniochilus, Sandberger.

Distr.—9 fossil, 10 recent sp. France. *L. Bourguignati*, Palad. (lxxii, 68).

Shell solid, spire elevated; peristome continuous, partly detached from the body-whorl on the left side; perforated.

BUGESIA, Paladilhe.

Distr.—*B. Bourguignati*, Palad. (lxxiii, 69).

Shell turreted, conic, with revolving grooves, and longitudinal costulæ; aperture ovate, slightly angular below and above, outer lip rounded; columella straight, compressed, not callous, slightly truncate at the base; imperforate. Operculum unknown. Microscopic. France.

BAIKALIA, Martens.

Syn.—*Limnorea*, Leucosia, Dybowski.

Distr.—20 sp. Lake Baikal; Colorado Desert (California). *A. Angarensis*, Gerst. (lxxiii, 70).

Shell turriculated, whorls usually convex, spire lengthened; aperture slightly angulated below. Operculum corneous, as in *Hydrobia*.

LIOLBAIKALIA, Martens. Whorls of the spire not in contact. Form resembling *Liogyrus* in *Valvatidæ*. *B. Stiedæ*, Dyb. (lxxiii, 71).

GODLEWSKIA, Crosse and Fischer. Shell having varices. *B. turriiformis*, Dyb. (lxxiii, 72).

TRACHYBAIKALIA, Martens, 1879. Shell Melaniform, longitudinally costate. *B. carinato-costata*, Dybowski (lxxxiii, 73).

With this group may also be united as a subgenus:—

TRYONIA, Stimpson. Shell perforate, elongated, turreted, subulate, acute at the summit and rather pointed at the base; surface longitudinally ribbed, plicated or cancellated, not spinose; whorls numerous, more or less shouldered; aperture small, oblique, rhombovate, somewhat pointed, effuse and sinuated at the base; outer lip thin and sharp, projecting below, inner lip appressed to the whorl above, peritreme continuous. Operculum and animal unknown. *Distr.*—Fresh water, semi-fossilized. Colorado Desert, Southern California. *B. clathrata*, Stimpson (lxxii, 74).

DYBOWSKIA, Dall., 1876. Ribs covered with a ciliated epidermis. *B. ciliata*, Dybowski. Lake Baikal.

POTAMOPYRGUS, Stimpson.

Distr.—Fresh water, New Zealand, Cuba. *P. Candeara*, d'Orb. (lxxiii, 75).

Shell ovate-conic, imperforate, apex acute, whorls coronated with spines; aperture ovate, outer lip acute. Operculum corneous. Rostrum moderate, tentacles very long, slender, tapering and pointed; eyes on very prominent tubercles; foot rather short, broadest in front and strongly auriculated.

PYRGIDIUM, Tournouer.

Distr.—Tertiary; Austria. *P. Tournoueri*, Neum. (lxxiii, 76). Shell small, pyramidal or turreted; aperture ovately pyriform,

subeffuse at the base, angulate above; peristome continuous, thickened, duplicate.

PROSOSTHENIA, Neumayr. Shell small, ovate-conical or turreted, longitudinally plicate; last whorl coarctate, deflected; aperture ovate, oblique, entire; peristome continuous, thickened, duplicate, outer lip protracted. Tertiary; Austria. *P. Schwarzi*, Neum. (lxxiii, 77).

FOSSARULUS, Neumayr. Shell small, subglobose, rimate, with revolving nodulous ribs, and longitudinal riblets; aperture widely ovate, effuse above and below; peristome continuous, thickened, duplicate. Tertiary; Austria. *P. Stachei*, Neum. (lxxiii, 78).

AMNICOLA, Gould and Haldeman.

Distr.—United States throughout, including California. *A. limosa*, Say (lxxiii, 79).

Shell small, turbinately globose, thin, smooth, perforate or umbilicate; aperture broadly ovate, not oblique, outer lip thin and sharp, not projecting anteriorly. Operculum corneous.

Foot rather short and broad, expanded and broadly rounded behind; rostrum short; tentacles cylindrical, blunt at their tips. Ova-capsules semilenticular, with a laminiform limb, each containing a single egg.

TOXOSOMA, Conrad.

Distr.—Tertiary; So. America. *T. eborea*, Conr. (lxxiii, 1).

Shell conical, polished, the aperture projecting, subovate, direct; peristome continuous. Columella concave, with a plait or tooth in the middle, not oblique; base rounded, subumbilicated. Mr. Conrad supposed this to be a land-shell; its position in the system cannot be accurately defined.

LIOSOMA, Conrad.

Distr.—Tertiary; So. America. *L. curta*, Conr. (lxxiii, 2).

Conical, polished; aperture subelliptical; columella with one plait in the middle; base entire. Position very doubtful.

SUBFAMILY LITHOGLYPHINÆ.

Shell small, globose, spire short, last whorl proportionally very large; lip sharp. Fresh water.

LITHOGLYPHUS, Muhlfeldt.

Distr.—Fresh water, So. E. Europe, So. America. *L. lapidum*, d'Orb. (lxxiii, 80, 81).

Shell globular, thick, smooth, imperforate; spire short; suture not impressed; aperture broadly subovate or nearly circular, inner lip callous, outer lip simple. Operculum corneous, rounded.

Animal (of *L. lapidum*). Foot large, longer than the shell; tentacles short, rather tapering and pointed.

BENEDICTIA, Dybowski. Shell Paludiniiform, very thin. Operculum spiral, corneous. *Distr.*—3 sp. Lake Baikal. *L. Baik-alensis*, Gerst. (lxxiii, 82).

JULLIENIA, Crosse and Fischer. Peristome expanded. Cam-bodia. *L. Jullieni*, Desh. (lxxiii, 83).

GILLIA, Stimpson.

Distr.—Fresh water, Eastern United States. *G. altilis*, Lea (lxxiii, 84).

Shell rather large, subglobular, thin, subperforate, smooth; spire small, suture not impressed; aperture large, broad-ovate, oblique; outer lip thin, acute, not projecting anteriorly. Operculum thin, corneous, regularly ovate.

Rostrum rather broad; tentacles tapering, pointed. Ova-capsules hemispherical, each containing a single egg; deposited singly or in groups or linear series. Probably a synonym of the next genus.

SOMATOGYRUS, Gill.

Distr.—Fresh water, central parts of the United States. *S. depressus*, Tryon (lxxiii, 85).

Shell rather large, globular, thin, smooth, perforate, spire small, suture impressed, body-whorl globose, more or less shouldered above; aperture large, oblique, rhombovate, narrowly rounded in front and back; peritreme thin and acute, its entire margin uniformly in one plane, the outer lip not projecting anteriorly. Operculum rather thick, corneous, subovate, inner margin concave above.

FLUMINICOLA, Stimpson.

Distr.—Fresh water, Oregon and California. *F. Nuttalliana*, Lea (lxxiii, 86).

Shell comparatively large, obliquely ovate, thick, smooth, im-perforate; spire moderate, obtuse; aperture ovate, inner lip flattened, callous, outer lip effuse and projecting anteriorly, so that the peritreme is not continuously in the same plane. Operculum corneous.

Rostrum rather large, tentacles tapering, foot broad.

COCHLIOPIA, Stimpson.

Distr.—Fresh water, California. *C. Rowelli*, Tryon (lxxiii, 87, 88).

Shell depressedconic; base concave and carinated; umbilicus large and deep; aperture oblique. Operculum thin, corneous, subspiral. Rostrum moderate, tentacles rather long, tapering.

LACUNOPSIS, Desh.

Distr.—3 sp. Cambodia. Fresh water. *L. Jullieni*, Desh. (lxxiii, 89).

Shell depressed, solid, neritiform; base plane, with a sub-marginal angle; aperture small, semilunar; lip and columella greatly thickened.

SPEKIA, Bourguignat, 1881. Growth-lines oblique, crossed at right-angles by striæ; a small obsolete funicle behind the columellar lip. *L. zonata*, Woodward (lxxiii, 90, 91). *L. Tanganyika*, Africa.

SUBFAMILY POMATIOPSISINÆ.

Shell and operculum as in Rissoinae. Foot with lateral sinus. Amphibious.

POMATIOPSIS, Tryon.

Syn.—Chilocyclus, Gill.

Distr.—United States, Central America. *P. lapidaria*, Say (lxxiii, 92).

Shell elongated, perforate, smooth, whorls very convex; aperture round; peristome continuous, slightly expanded or reflected.

The animal of Pomatiopsis prefers damp locations in the vicinity of streams, but does not, like Amnicola, live habitually under water. It is an air-breather, but possessed of a true gill. Its locomotion is effected by first protruding and attaching the snout, then carrying the front of the body forward, and finally drawing the posterior parts after, a motion very like that of Assiminea and very different from Amnicola.

FAMILY ASSIMINIIDÆ.

Shell small, globose-conical, with sharp lip. Operculum paucispiral, corneous.

Animal with eyes at or near the ends of the tentacles as in the helices.

Terrestrial or amphibious.

ASSIMINEA, Leach.

Syn.—Syncera, Gray. Optedicerus, Leith. Hydrocena, in part.

Distr.—Europe, Asia, America, a few species. *A. Grayana*, Leach (lxxiii, 93).

Shell not perforated or slightly slit, oval-conic, with moderate spire; aperture rounded-oval, entire; columellar lip somewhat thickened. Animal. Tentacles rather short, the eye-peduncles connate with them to their ends. The Indian species, *A. Francesiæ*, can often be seen for days together on dry land, walking or rather leaping with great rapidity like a caterpillar of the

Geometridæ. As the animal proceeds, the rostrum and the small foot are moved alternately.

PALUDINELLA, Pfeiffer. Shell turbinated, oval or depressed, umbilicated; whorls rounded; aperture subcircular, lip simple, usually continuous. Amphibious, living in marshes usually near the sea. *A. littorea*, Chiaje (lxxiii, 18).

ACMELLA, Blanford. Shell ovate, with a corneous epidermis; aperture ovate, the margin obtuse. Operculum corneous, thin, paucispiral. Animal like Assiminea, with short proboscis, tentacles short obtuse, with eyes on their sides, foot moderate, obtuse. *A. tersa*, Benson (lxxiii, 94). Damp places, Khasi hills, India. A land rissoid allied to Assiminea.

HYDROCENA, Parreyss. (Georissa, Blanf.) Shell imperforated or umbilicated, globosely turbinated; aperture oval. Operculum thin, corneous paucispiral. Dalmatia, India. Terrestrial. *A. Cattaroensis*, Pfr. (lxxiii, 95).

LAGUNCULA, Benson, 1856. (Bensonina, Cantraine.) Shell turbinated, subglobular; aperture oblong, large; outer lip a little reflected; umbilicus profound, tortuous. *A. pulchella*, Benson. Chusan.

FAMILY VALVATIDÆ.

Shell depressed conical or almost discoidal; umbilicated; covered by a thin greenish epidermis. Operculum orbicular, corneous, multispiral.

Animal with a produced muzzle; tentacles long and slender, eyes at their outer bases; foot bilobed in front; branchial plume long, pectinated, partially exerted on the right side, when the animal is walking. Lingual teeth broad; uncini 3, lanceolate; all hooked and denticulated (xi, 24).

VALVATA, Müller.

Syn.—Valvatinella, Betta. Cincinna, Hübner.

Distr.—Fresh water, mundane. *V. piscinalis*, Müll. (lxxiii, 96).

Shell depressed conical (in the typical group). Other characters, those of the family.

The species are of small size, living in ponds and ditches and slow-running water, principally in North America and Europe. When the animal is moving, the delicate, retractile branchial plume is projected over the neck. The female deposits her eggs in a single, coriaceous, spherical capsule, which is affixed to stones or the stems of aquatic plants.

GYRORBIS, Fitzinger. (Planorbitina, Betta. Planella, Schlüt.) Shell discoidal, depressed, widely umbilicated, whorls rounded. Europe, America. *V. cristata*, Müller (lxxiii, 97).

TROPIDINA, H. and A. Adams. Shell turbinated, whorls carinated. N. America. *V. tricarinata*, Say (lxxiii, 98, 99).

LYOGRUS, Gill. (Heterocyclus, Crosse.) Spire elevated, the last whorl becoming detached from the close spiral near the aperture. U. S., New Caledonia. *V. pupoidea*, Gould (lxxiii, 100).

FAMILY PALUDINIDÆ.

Shell conical or globular, with a thick, olive-green epidermis; aperture rounded; peristome continuous, entire. Operculum horny.

Animal with a broad entire muzzle; tentacles short and rather stout; eyes on short pedicels, outside the tentacles. Inhabiting fresh waters in all parts of the world. Dentition (xi, 25).

PALUDINA, Lam.

River-snail. *Etym.*—*Palus* (*paludis*), a marsh.

Syn.—*Vivipara*, Montf. *Viviparella*, Raf.

Distr.—100 sp. Fresh water, mostly in the Northern hemisphere, Australia.* Fossil, 75 sp. World-wide. Jurassic—. *P. Bengalensis*, Lam. (lxxiv, 6).

Shell turbinated, with round whorls; aperture slightly angular behind; peristome continuous, entire. Operculum horny, concentric. Animal with a long muzzle, and very short eye-pedicels; neck with a small lappet on the left side, and a larger on the right, folded to form a respiratory siphon; gill comb-like, single; tongue short; teeth single, oval, slightly hooked and denticulated; uncini 3, oblong, denticulated. The Paludinæ are viviparous; the young continuing for some time after they are hatched within the parent shell.

PALUDINA (restricted). Whorls rounded, generally banded, rather thin, umbilicated. The European species have three bands, those of the United States four bands, whilst the numerous banded species are Oriental.

MELANTHO, Bowdich. Whorls smooth, flattened around their upper portion, generally not banded, solid, nearly or quite imperforate. Peculiar to the United States, *P. integra*, Say (lxxiv, 7).

TULOTOMA, Hald. Whorls angulated, nodulous, flattened around their upper portion. *P. bimonilifera*, Lea (lxxiv, 8).

MARGARYA, Nevill. Spire produced; whorls scalariform, with deep suture, sculptured with prominent spiral ribs; apex obtuse; rimate. Operculum and animal unknown. *Distr.*—*P. Melanoides*, Nevill (lxxiv, 9). Lake Tali, Yunnan. Closely allied to the American subgenus Tulotoma.

NEOTHAUMA, E. A. Smith. Shell with aperture effuse and slightly channeled at the base; outer lip rather deeply, yet

* There are no So. American species, nor in N. Am. west of the Rocky Mountains.

widely, sinuated in the middle. *P. Tanganyicense*, Smith (lxxiv, 10). Lake Tanganyika, Africa.

TANGANYICIA, Crosse. Shell globose, ampullariform, rimate, covered by a very thin epidermis; columellar lip lobed below. Operculum at first spiral, afterwards concentric. *P. rufofilosa*, E. A. Smith (lxxiv, 11). Lake Tanganyika.

MEKONGIA, Crosse and Fischer. Aperture contracted, appearing like a gigantic Stenothyra. Cambodia. *P. Jullieni*, Desh. (lxxiv, 12).

LARINA, A. Ad.

Syn.—Robinsonia, H. Nevill.

Shell imperforate, semiglobose, thin; spire obtuse, whorls few, tumid, covered with an olivaceous epidermis, last whorl large and ventricose; aperture wide, ovate; outer lip simple, regular, acute. Operculum annular, horny, ovate. Moreton Bay, Australia; possibly from a stream in the vicinity.

Adams thinks it is related to Paludina, but it may be a marine shell, and I have included it in the Naticidæ of this work (p. 206). Several Indian species, apparently of the same genus, have been described under the generic name of Robinsonia. *R. Ceylonica*, Nevill (lxiii, 51).

CLEOPATRA, Troschel.

Distr.—Several species. Egypt and E. Africa. *C. bulimoides*, Oliv. (lxxiv, 13).

Shell turbate, with moderate spire. Operculum subspiral. The spire is more elevated than in Paludina, and the operculum differs.

LIOPLAX, Troschel.

Syn.—Haldemania, Tryon.

Distr.—A few United States species. *L. subcarinata*, Say (lxxiv, 14).

Shell with elevated spire, very convex, somewhat carinated or angulated whorls, and deep sutures. Operculum concentric, but with a spiral nucleus.

LIOPLACODES, Meek. Differs from Lioplax in its more elongated form, smaller body-whorl, more constricted suture, aperture angular posteriorly; peritreme continuous; umbilicate. *L. veterna*, Meek and Hayden. Jurassic; U. S.

FAMILY AMPULLARIIDÆ.

Shell globular, with large body-whorl, and more or less depressed spire; sometimes planorboid. Aperture slightly expanded. Operculum concentric.

Animal with a long siphon, formed by the left neck-lappet; left gill developed, but much smaller than the right; muzzle

produced into two long tentacular processes; tentacles extremely elongated, slender. Dentition (xi, 22, 23). Inhabits lakes and rivers throughout the warmer parts of the world, retiring deep into the mud in the dry season, and capable of surviving a drought, or removal from the water for several years. In the Lake Mareotis, and at the mouth of the Indus, Ampullariæ are abundant, mixed with marine shells. Their eggs are large, enclosed in calcareous capsules, and aggregated in globular masses around the stems of plants, etc.

These fluviatile mollusks represent in the ponds and rivers of the tropics, the Paludinae of more temperate climates. Although distinct gills exist, the respiratory cavity is very large and partly closed, so as to enable these animals to live a long time out of water; in fact, they appear to be truly amphibious.

AMPULLARIA, Lam.

Apple-snail. *Etym.*—*Ampulla*, a globular flask.

Syn.—*Pachylabra*, Swains.

Distr.—150 sp. Tropical, in fresh water. West Indies, Central and South America, southern portion of the United States, Africa, India, East Indies. *A. ampullacea*, Linn. (lxxiv, 15).

Shell globular, with short spire; epidermis green, polished, sometimes banded or spotted; usually umbilicated.

Typical.—Aperture slightly thickened within the margin. Operculum with an inner calcareous layer. Oriental exclusively.

SAULEA, Gray. Shell ovate, subglobose, very thin, parchment-like, elastic, dark-colored, variegated, covered with a very thin, hard, olive epidermis; upper whorls minutely keeled, others rounded; axis imperforate. Operculum thin, shelly, elastic. Sierra Leone. *A. vitrea*, Gray.

POMUS, Humphrey. Differs from Ampullaria in the absence of a thickened internal ledge of the lip, and in the operculum being entirely horny. American exclusively. *A. canaliculata*, Lam. (lxxiv, 16).

POMELLA, Gray. Shell suboval, solid, not umbilicated; whorls striated, the last very large; spire very short or depressed; aperture very large; peristome thin, expanded. Operculum horny. South America. *A. neritoides*, d'Orb. (lxxiv, 17).

ASOLENE, d'Orb.

Syn.—*Ampulloidea*, d'Orb. *Ampullaroides*, Gray.

Distr.—South America. *A. Platæ*, d'Orb. (lxxiv, 18).

Shell subglobular, spire slightly elevated; aperture oval; the inner lip somewhat thickened, forming a continuous peristome. Operculum corneous, with an inner calcareous layer. Animal without a long respiratory siphon.

LANISTES, Montfort.

Distr.—East Africa. *L. Bolteniana*, Chemn. (lxxiv, 19).

Shell sinistral, depressed; umbilicated; peristome simple, sharp. Operculum horny.

MELADOMUS, Swainson. Shell sinistral, oval-conic, not umbilicated. Africa. *L. olivacea*, Sowb. (lxxiv, 20).

MARISA, Gray.

Syn.—Ceratodes, Guilding.

Distr.—A few species. So. America, West Indies. *M. cornuarietis*, Linn. (lxxiv, 21). *M. Chiquitensis*, d'Orb. (lxxiv, 23).

Shell flattened or planorbiform, spire depressed or very slightly elevated; widely umbilicated; aperture expanded. Operculum horny.

FAMILY TRUNCATELLIDÆ.

Shell subcylindrical or turbinate, with elevated spire, apex obtuse or truncate; aperture oval, entire, peristome continuous. Operculum subspiral.

Animal with short, diverging triangular tentacles, and eyes at their bases. Amphibious, inhabiting usually margins of streams, salt marshes, damp places, etc. The relationship of these mollusks with the Rissoids and Assiminiæ is very close, so that they may be considered as terrestrial Rissoidæ; on the other hand, they connect with the typical operculated land-shells, the Cyclostomæ.

TRUNCATELLA, Risso.

Looping snail. *Syn.*—Choristoma, Crist. and Jan. Erpetometra, Lowe.

Distr.—62 sp. World-wide, mostly tropical. Fossil. Eocene; Paris basin. *T. truncatula*, Drap. (lxxv, 24).

Shell minute, cylindrical, truncated; whorls striated transversely; aperture oval, entire; peristome continuous. Operculum corneous, subspiral.

Animal with short, diverging, triangular tentacles; eyes centrally behind; head bilobed; foot short, rounded at each end.—FORBES.

The Truncatellæ are found on stones and sea-weeds between tide-marks, and survive many weeks out of the water.—LOWE. They walk by contracting the space between their lips and foot, like the geometric caterpillars.—GRAY. They are found semi-fossil along with the human skeletons in the modern limestone of Guadaloupe.

TAHEITEA, H. and A. Ad. Operculum calcareous, radiately lamellate. Aperture usually more or less separated from the preceding whorl. Polynesia. *T. Vitiana*, Pease. Viti Isles.

CECINA, A. Ad., 1861. Shell imperforate, subcylindrical, epidermis olivaceous; apex obtuse, eroded, not truncate; whorls flat, smooth; aperture ovate, vertical, rounded in front, acuminate behind; the continuous lip flexuous and subproduced in the middle. Operculum corneous, paucispiral. Tentacles lobi-form, with obtuse apices, the large eyes at their external bases. Rostrum elongate, cylindrical, annulate. Foot short, oblong. Manchuria. *T. Manchurica*, A. Ad.

GEOMELANIA, Pfeiffer.

Etym.—*Ge*, the ground (*i. e.* terrestrial), and *Melania*.

Distr.—21 sp. Jamaica. *G. Jamaicensis*, Pfr. (lxxv, 25).

Shell imperforate, turreted; aperture entire, effused; peristome simple, expanded; margins joined, basal produced into a tongue-shaped process. Operculum oval, pellucid, whorls few, rapidly enlarging.

BLANDIELLA, Guppy. Labrum without linguiform appendage. Operculum paucispiral, inner side cartilaginous, externally calcareous, rugose. 1 sp. Trinidad, W. I. *G. reclusa*, Guppy (lxxv, 26, 27).

CHITTIA, Livesay. Shell imperforate, conic, cylindrical; aperture ovate, moderately effuse, peristome thickened, sharply reflected, not produced, with a sinus on the inner side near the axis. *C. sinuosa*, Chitty (lxxv, 28). There is only the type species; but *Aciculina emarginata*, Desh., an eocene fossil of the Paris basin, may also be referred to this subgenus.

RENEA, Nevill.

Etym.—Named in honor of J. René Bourguignat.

Distr.—2 sp. Southern France. *R. Bourguignatiana*, Nevill (lxxv, 29, 30).

Shell imperforate, elongated-cylindrical, whorls numerous, compressed, costulate; margin of peristome obtuse, thickened within, without external marginal varix; outer lip with a pleurotomoid sinus posteriorly; columella nearly perpendicular, slightly twisted above, where it presents a superficial, channel-like indentation.

TOMICHTIA, Benson.

Distr.—India, Japan, So. Africa. *T. ventricosa*, Sowb. (lxxv, 31).

Shell with elongated spire and generally truncated apex; perforated; peristome continuous, double or triple. Operculum paucispiral.

BLANFORDIA, Ad.

Etym.—Named in honor of W. T. Blanford.

Distr.—4 sp. Japan, Australia. *B. Japonica*, A. Ad. (lxxv, 32).

Shell ovately conical, epidermis olivaceous, smooth, apex

truncated; aperture elliptical, peristome continuous, thickened, duplicate, subacute within, subvaricose without. Operculum corneous, subspiral.

Rostrum elongated, transversely corrugated, emarginate in front; tentacles very short, triangular, depressed, the eyes at their bases; foot large, divided by a transverse sulcus.

ACICULA, Hartmann.

Syn.—Acme, Hartmann. Pupula, Agassiz. Auricella, Jurine.

Distr.—22 sp. Europe, No. Africa. *A. spectabilis*, Rossm. (lxxv, 33).

Shell minute, slender, nearly imperforate; peristome slightly thickened, margins subparallel, joined by a thin callus. Operculum very thin, transparent, paucispiral.

FAMILY CYCLOSTOMIDÆ.

Shell spiral, rarely much elongated, often depressed, spirally striated; aperture nearly circular; peristome simple. Operculum distinctly spiral.

Animal with the eyes on slight prominences at the outer bases of the tentacles; tentacles contractile only; foot rather elongated.

Teeth recurved, hooked, in seven rows, arranged in a semi-lunar manner on a narrow lingual band (xi, 21). Mouth probosciform, not provided with horny jaws. Respiratory organ reticulate, in the form of a sacciform cavity on the back of the neck; edge of the mantle free from the nape, leaving the respiratory cavity open. Sexes distinct. Oviparous, for the most part terrestrial, and respiring free air.

The tentacles are simply contractile, and not retractile by inversion as in the Helicidæ, and the eyes are usually sessile on the head near the bases of the tentacles, instead of being elevated on peduncles as in that family.

The animal of the Cyclostomidæ is very like that of the periwinkle (Littorina), differing chiefly in the situations it inhabits and the medium respired. The operculum presents many beautiful modifications of structure characteristic of the smaller groups, which are often peculiar to limited regions, as in the Helicidæ. The oldest fossil species are Eocene.

I. *Pomatiasinæ*.

POMATIAS, Studer.

Distr.—80 sp. So. Europe, several in N. Africa and India. *P. obscurus*, Lam. (lxxv, 38).

Shell slender, turreted, longitudinally striated; peristome subcontinuous, reflected. Operculum cartilaginous, paucispiral, composed of two plates and concamerated between them.

HAGENMUELLERIA, Bourg., 1882. 2 sp. Algiers. *P. Pechaudi*, Bourg.

CARDIOSTOMA, Sandberger. *P. trochulus*, Sandb. Eocene; Europe.

REALIA, Gray.

Syn.—Liarea, Gray. Hydrocena, Auct. (in part).

Distr.—25 sp. Mauritius, Philippines, Polynesia. *R. egea*, Gray (lxxv, 39).

Shell turreted or turbate, nearly smooth; perforated; aperture oval; peristome continuous, straight or expanded. Operculum paucispiral, thin, corneous.

CYCLOMORPHA, Pease. Shell turbate, subglobose, solid, smooth, or spirally striate, perforate; aperture nearly circular; peristome simple, somewhat thickened, connected on the columellar side by a thin callus. Operculum paucispiral. 2 sp. Polynesia. *R. flava*, Brod. (lxxv, 40).

OMPHALOTROPIS, Pfeiffer. Shell turreted or globosely turbinated, carinated around the umbilical perforation; aperture oval; peristome expanded or simple. Polynesia. *R. rubens*, Quoy (lxxv, 41, 42).

JAPONIA, Gould, 1859. Globosely conical, whorls contiguous, but scarcely impinging; umbilicus open; decussated by lamellar growth-lines and revolving liræ. Operculum thin, paucispiral. 3 Japanese species. *R. musiva*, Gld.

SCALINELLA, Pease. Shell scalariform, narrowly perforate; whorls rounded, longitudinally costate, suture profound; lip subcircular, continuous, barely or not in contact, simple. Polynesia. *R. Taheitensis*, Pease (lxxv, 43).

ATROPIS, Pease. Shell elongate, sometimes cylindrical, rarely ovate, imperforate, in the species of ovate form narrowly perforate; aperture ovate, occasionally circular; peristome continuous, sometimes disconnected from the penultimate whorl and very slightly porrected. Last whorl frequently obtusely angulate on its periphery, of one color, usually pale yellow or reddish. Polynesia. *R. Caledonica*, Crosse (lxxv, 44).

II. Pupinea.

PUPINA, Vignard.

Syn.—Eupupina, Pfr. Moulinsia, Grat.

Distr.—42 sp. East Indies, Japan, Philippines, Australia. *P. bicanaliculata*, Sowb. (lxxv, 45).

Shell subcylindrical, usually polished; aperture circular, peristome thickened, notched in front and at the suture. Operculum membranous, narrow-whorled.

REGISTOMA, Van Hasselt. (Rhegostoma, Agassiz). Shell pupiform, thin, transparent, smooth, polished; whorls displaced, apex papilliform; peristome reflected, with a narrow channel

in the middle of the columellar side. *P. grande*, Gray (lxxv, 46, 47).

CALLIA, Gray. Shell smooth, shining, pupiform; aperture without sinus; peristome simple, thin. *P. lubrica*, Sowb. (lxxv, 48).

HARGRAVESIA, H. Adams. (Hyalopsis, Pease.) Shell like *Pupina*, but anterior marginal slit or canal absent, distinctly channeled posteriorly. *P. polita*, H. Ads. (lxxv, 50).

PUPINELLA, Gray.

Distr.—13 sp. East Indies, Formosa, Philippines, Australia, etc. *P. pupiniformis*, Sowb. (lxxv, 51, 52).

Shell oval-oblong, covered with a thin, corneous epidermis; aperture circular; peristome thick, reflected, slit on the anterior left side and canaliculate at the suture. Operculum corneous, multispiral.

PUPINOPSIS, H. Adams, 1866. Peristome tubularly prolonged on the penultimate whorl. *P. Swinhoei*, H. Ad. Formosa.

RAPHAULUS, Pfeiffer.

Syn.—*Anaulus*, Pfeiffer.

Distr.—5 sp. East Indies. *R. bombycinus*, Pfr. (lxxv, 53).

Shell umbilicated, pupiniform, peristome double, internal continuous, external dilated, perforated at the margin by a canal; canal sutural and internal, terminating anteriorly, and embraced by the outer portion of the double peristome (it can be traced externally along the last whorl), and reaching into the concavity of the spire. Operculum very thin, corneous; narrow-whorled.

"The use of the sutural tube seems to be the preservation of a communication with the external air when the aperture is closed."—BENSON.

STREPTAULUS, Benson. Shell pupiniform, shining, peristome circular, not continuous, with a subsutural internal tube, which is reflexed at the aperture and runs along the suture externally. 1 sp. Himalayas. *R. Blanfordi*, Benson (lxxv, 54).

CATAULUS, Pfeiffer.

Distr.—17 sp. Ceylon. *C. pyramidatus*, Pfr. (lxxv, 55).

Shell pupa-shaped, with the base keeled, producing a channel in the front of the aperture. Operculum circular, horny, the whorls easily separable. Represents in Ceylon a group approaching *Megalomastoma*. The whorls of the operculum, when macerated, separate and may be unrolled in spiral form.

TORTULOSA, Gray. Last whorl solute. Nicobar. *C. tortuosa*, Chemn. (lxxv, 56–58).

MEGALOMASTOMA, Guilding.

Syn.—*Lomastoma*, Woodward.

Distr.—29 sp. W. Indies, E. Indies, India, Madagascar, Mauritius. Fossil. Eocene—. Paris and Isle of Wight. *M. Antillarum*, Sowb. (lxxv, 59).

Shell oblong or pupa-shaped, scarcely perforated, aperture circular. Operculum thin, horny, many-whorled, flat.

FARCIMEN, Troschel. Lip thickened. W. Indies. *M. ventricosum*, d'Orb. (lxxv, 60).

MEGALOMASTOMA, Guild. Lip rather thin. W. Indies.

COPTOCHEILUS, Gould. Narrowly perforate; aperture slightly touching or not touching the body-whorl; peristome not thickened, more or less duplicate. E. Indies. Scarcely distinct from *Megalomastoma* (restricted). *M. altum*, Sowb. Philippines.

TOMOCYCLUS, Crosse and Fischer. Shell perforate, turreted, truncate; aperture subcircular, small; peristome duplex, the inner margin direct, the outer margin widely expanded, excised above. Operculum with a median posterior rounded process, margins of the whorls sublamellate. Central America, Guatemala. *M. simulacrum*, Morel. (lxxv, 61).

HAINESIA, Pfeiffer, 1856.

Syn.—*Mascaria*, Angas.

Distr.—4 sp. Madagascar, Siam. *H. Myersi*, Haines.

Shell oblong-turreted, whorls convex, without epidermis, resembling *Megalomastoma*. Operculum angular, paucispiral.

DACRYSTOMA, Crosse and Fischer, 1871. Whorls flattened, with very thin, deciduous epidermis. *H. arboreum*, C. and F. Madagascar.

DIPLOMMATINA, Benson.

Distr.—100 sp. India, East Indies, Australia, Polynesia. *D. folliculus*, Pfr. (lxxv, 62, 63).

Shell suboval, costulate, dextral or sinistral, thin, scarcely perforated; aperture subcircular; peristome double, outer margin expanded. Operculum horny, multispiral. The eyes are situated on the hind-part of the tentacles, at their base, and are composed of two lobes, one lobe deeply seated in the tentacle and larger than the other lobe, which is a small black point coming to the surface on the outer side of the larger lobe. The generic name is derived from this peculiarity of the eyes.

PAXILLUS, H. and A. Adams. Shell small, pupiform, sinistral, rimate; spire pointed; aperture semioval, ascending on the body-whorl; inner lip spreading, 1-plaited, outer lip expanded, notched in front; umbilicus defined by a rib. *D. rubicunda*, Martens (lxxv, 64).

DIANCTA, Martens. Penultimate whorl constricted. *D. constricta*, Martens (lxxv, 65, 66).

NICIDA, Blanford. Shell smooth or spirally striate, imperforate. Operculum corneous, subobsoletely multispiral. *D. Niligirica*, Blanf. (lxxv, 67).

PALAINA, Semper. (Pupoidea, Pease.) First two or three whorls much smaller than the others (deciduous?). Operculum membranaceous, multispiral. *D. scalariformis*, Pease (lxxv, 68).

CLOSTOPHIS, Benson, 1860. Shell subbiconical; the penultimate whorl large, the last descending, solute, subaxial, small; aperture with continuous peristome, and parietal tooth. Operculum unknown. *D. Sankeyi*, Benson. Caverns near Moulmein.

MOUSSONIA, Semper. Peristome nearly continuous with a tooth upon the centre of the left margin. *D. typica*, Semper (lxxv, 69).

ARINIA, H. and A. Adams. Shell subimperforated, thin, smooth, shining, turriculated, obtuse at the summit, last whorl swollen; aperture subcircular; margin nearly continuous; columellar lip angularly dilated in the middle. Operculum thin, calcareous, paucispiral. *D. minor*, Sowb. (lxxvi, 70).

OPISTHOSTOMA, Blanford.

Syn.—Plectostoma, Adams. Scoliostoma, Crespigny.

Distr.—5 sp. India, Borneo, West Africa. *O. Fairbanki*, Blanford (lxxvi, 71).

Shell pupiform, umbilicated, with a regular costulated ornamentation; apical whorls obliquely distorted; last whorl strangled, separated from the others, and applied to the penultimate; peristome double, free portion prolonged backwards. Operculum horny (?).

O. De Crespigni, Adams (Plectostoma), has a conical spire, and the apical whorls are not excentric to the axis of the lower whorls.

III. Cyclostomea.

ADAMSIELLA, Pfeiffer.

Distr.—16 sp. West Indies.

Shell pupiform or oblong-turreted; aperture small, subcircular; peristome usually double, more or less expanded or reflected. Operculum thin, rather cartilaginous, whorls few, with subcentral nucleus. *A. mirabilis*, Wood (lxxvi, 72).

DIPLOPOMA, Pfeiffer.

Distr.—*D. architectonicum*, Gundl. (lxxvi, 73, 74).

Shell oblong-turreted. Operculum subduplicate, acutely separated at the margin; inner layer concave, smooth; outer layer inflated, calcareous, paucispiral, nucleus profoundly immersed.

CTENOPOMA, Shuttleworth.

Distr.—26 sp. West Indies. *C. bilabiatum*, d'Orb. (lxxvi, 75, 76).

Shell ovate or cylindrically turreted, truncate; aperture sub-circular; peristome expanded, mostly duplicate; umbilicate or perforate. Operculum testaceous, rather narrowly spiral, the whorls obliquely sulcate, nucleus nearly central.

CYCLOTOPSIS, W. T. Blanford.

Distr.—3 sp. India, Mauritius. *C. semistriata*, Sowb. (lxxvi, 77).

Shell widely umbilicate, turbinately depressed, spirally lirate; aperture subcircular. Operculum multispiral, duplex, membranaceous within, testaceous externally with the margins of the whorls elevated.

CHOANOPOMA, Pfeiffer.

Distr.—55 sp. W. Indies. *C. lima*, C. B. Ad. (lxxvi, 78, 79).

Shell globular-turbinated or turreted, spire frequently truncated; aperture suboval or circular; peristome usually double, reflected. Operculum testaceous, the margins of the whorls usually free, ribbed.

LICINA, Gray. Last whorl sometimes detached near the aperture; peristome subreflected. *C. evoluta*, Reeve (lxxvi, 80).

JAMAICEA, C. B. Adams. Shell umbilicated, globular-conic; peristome simple or double, straight or reflected. Operculum externally convex, its whorls obliquely striated, sublamellar. *C. anomala*, Ad. (lxxvi, 81).

CHONDROPOMA, Pfeiffer.

Distr.—100 sp. West Indies. *C. magnificum*, Sallé (lxxvi, 82).

Shell oblong-turreted, or globular-turbinated, frequently the apex is truncated; aperture oval; lip simple or more or less double, nearly direct, a little expanded or reflected. Operculum oval, subcartilaginous, flat, paucispiral.

CISTULA, Gray.

Distr.—42 sp. West Indies and neighboring continent. *C. Sauliæ*, Sowb. (lxxvi, 83).

Shell globular-conic or oval, or oblong-turreted, apex usually truncated; aperture oval; peristome single or double, reflected. Operculum thin, cartilaginous, paucispiral, with rapidly enlarging whorls.

TUDORA, Gray.

Distr.—34 sp. West Indies and neighboring continent. *T. mumia*, Lam. (lxxvi, 84).

Shell oval-oblong or turreted; aperture oval, angular posteriorly; peristome single or double, expanded. Operculum oval,

testaceous externally, flat, paucispiral; the whorls obliquely sil-lonated or striated, nucleus very excentric.

LEONIA, Gray. Peristome simple, subreflected. Operculum oval, calcareous, unispiral, convex externally, nucleus lateral, near the columellar lip. *T. mamillaris*, Lam. (lxxvi, 85). Southern Europe.

CYCLOSTOMA, Lam.

Etym.—*Cyclos*, circle, and *stoma*, mouth.

Distr.—120 sp. About half in Madagascar, a few in the East and West Indies, two or three in Europe. *C. sulcatum*, Lam. (lxxvi, 86). *C. elegans*, Müll. (lxxvi, 87).

Shell globular-conic or turriculated, thin, more or less widely umbilicated; aperture subcircular; peristome single or double, straight or slightly reflected. Operculum calcareous, paucispiral, flattened, nucleus excentric.

Animal with clavate tentacles; sole of the foot divided by a longitudinal groove, the sides moved alternately in walking; the end of the long muzzle is also frequently applied, as by the looping-snails (*Truncatellæ*), and used to assist in climbing.

TROPIDOPHORA, Troschel. Shell depressed turbinatè, widely umbilicated or imperforate, with revolving carinæ and striæ; lip reflected, sometimes covering a part of the umbilicus. A group of usually large species inhabiting Madagascar. *C. Cuvierianum*, Petit (lxxvi, 88).

LITHIDION, Gray. Shell depressed, widely umbilicated; aperture subcircular; peristome simple, thin or thickened. Operculum paucispiral, with a strong subcentral carina. *C. lithidion*, Sowb. (lxxvi, 89).

REVOILIA, Bourguignat, 1881. (Dedicated to M. Georges Révoil.) Shell depressed, discoidal, spirally ridged; umbilicus wide in young individuals, but entirely closed in adults by a thin dilation of the columellar lip; peristome continuous, dilated-reflexed, the lip slightly ascending against the body-whorl above. *R. Milne-Edwardsi*, Bourg. E. Africa. Closely allied to Lithidion.

OTOPOMA, Gray. Shell subglobose, umbilicated; peristome simple or a little reflected, with an ear-like process covering part of the umbilicus. Operculum convex in the middle. 19 sp. Socotra, Madagascar, Zanzibar, Mauritius, India. *C. Naticoides*, Recl. (lxxvi, 90).

LIGATELLA, Martens. Shell rounded, turbinatè-conical, usually banded; peritreme simple. Cape of Good Hope, Mauritius, Madagascar. *C. ligatum*, Müll. (lxxvi, 91).

GEORGIA, Bourguignat, 1882. (Dedicated to Georges Révoil.) Umbilical region entirely covered by a callous expansion of the inner lip, which is not continuous with the labrum above. Operculum perforated in the centre, interiorly concave, spiral, covered by a mucilaginous membrane, externally convex, four-whorled,

the whorls rapidly increasing, thickened along the canaliculated suture and terminating in a tongue-like, narrow projection, appressed to the circumference of the last whorl. *C. Naticoides*, Recluz. Several species, East Africa.

ROCHEBRUNIA, Bourguignat, 1882. (Dedicated to Dr. Rochebrune, of the Museum, Paris.) Inner lip without umbilical dilation, so that the umbilicus is open. *C. Philippianum*, Pfeiffer. 11 sp. East African region.

IV. *Cyclophorea*.

Operculum thin, corneous, multispiral. The animals of this extensive group are found in the humid parts of tropical forests, either concealed among the débris at the roots of trees, or inhabiting the branches and foliage; some, however, prefer dry and arid situations, while others take up their abode in the immediate vicinity of the sea.

CYCLOPHORUS, Montfort.

Etym.—*Cyclos*, circle, *phoreus*, bearer.

Distr.—200 sp. Tropical, mundane. *C. volvulus*, Müll. (lxxvi, 92).

Shell depressed, openly umbilicated; aperture circular; peristome continuous, straight or expanded; epidermis thick. Operculum horny, many-whorled.

Animal with long, slender, pointed tentacles; foot broadly expanded, not grooved.

MYXOSTOMA, Troschel. Shell discoidal, widely umbilicated; peristome double, the internal margin continuous, external margin reflected, and produced into a tongue-like form posteriorly. *C. Troscheli*, Benson (lxxvi, 93).

THEOBALDIUS, Nevill. Shell subdiscoidal, widely umbilicated; peristome circular, thickened, not much reflected, continuous. Asiatic. *C. annulatus*, Nevill (lxxvi, 94).

SCABRINA, Blanford. Shell depressed, subdiscoidal, widely umbilicated; epidermis hispid; whorls rounded; aperture circular, peristome thickened. Operculum thick, corneous, the margins of the whorls lamellately elevated. Asiatic. *C. calyx*, Benson (lxxvi, 95).

BUCKLEYIA, Higgins. Shell discoidal, widely umbilicated; with revolving carinæ, and deciduous epidermis; aperture circular, vertical, margin continuous, adnate, thin, acute. So. America. *C. Martinezii*, Hidalgo (lxxvi, 96, 97).

MICRAULAX, Theobald. Proposed for planorboid species uniting the Myxostoma type with the turbinate Lagocheilus.

LAGOCHEILUS, Blanford. Shell conoid-subturbinat, perforated, thin; aperture round, with a narrow incision in the posterior angle. Operculum thin. Animal with a glandular slit at the

upper posterior end of the foot. Indian. *C. tomotrema*, Benson (lxxvi, 98).

DITROPIS, Blanford. Shell subvitreous, translucent, with revolving carinæ, one of which is on the periphery. Operculum with the margins of the whorls raised. Indian. *C. convexus*, Blanf. (lxxvi, 99).

ACROPTYCHIA, Crosse and Fischer. (Euptychia, C. and F.) Shell globosely turbinate, thin, longitudinally ribbed; aperture subovate-circular, the margin shortly expanded; umbilicated. Operculum corneous, paucispiral. 1 sp. Madagascar. *C. metableta*, C. and F. (lxxvi, 100, 1).

LEPTOPOMA, Pfeiffer.

Distr.—65 sp. E. Indies, Philippines, Australia. *L. perplexum*, Sowb. (lxxvi, 2.) *L. acutimarginatum*, Pfr. (lxxvi, 11).

Shell turbinated, globular or conic, narrowly umbilicated; aperture rounded; peristome nearly continuous, single or double, reflected. Operculum flattened, membranous.

DERMATOCERA, H. and A. Adams. Animal with a conical epidermal horn on the hind-part of the foot. *L. vitreum*, Lesson (lxxvi, 3, 4).

LEUCOPTYCHIA, Crosse. Shell thinly costate longitudinally, and with several spiral striæ. *C. Tissotianum*, Crosse (lxxvi, 5).

AULOPOMA, Troschel.

Distr.—4 sp. Ceylon. *A. Itieri*, Guérin (lxxvi, 6).

Shell depressed, turbinated or subdiscoidal, the last whorl anteriorly detached; peristome free, straight, continuous. Operculum corneous, larger than the aperture of the shell, and having a circular groove to receive the margin of the latter.

CRASPEDOPOMA, Pfeiffer.

Syn.—*Bolania*, Gray.

Distr.—9 sp. Canaries, Madeira. *C. lucidum*, Sowb. (lxxvi, 7).

Shell subturbinated, rimate, the last whorl subcontracted anteriorly. Operculum round, horny, externally plane, internally concave with a submarginal ridge.

V. *Cyclotea*.

Operculum more or less thick, formed of two lamina, internally corneous, externally calcareous, multispiral.

CYATHOPOMA, Blanford.

Distr.—10 sp. India, Mauritius, Seychelles. *C. Deccanense*, Blanf. (lxxvii, 8, 9).

Shell minute, umbilicated, turbinated, or somewhat depressed; epidermis thick, sometimes hispid, smooth, spirally striated, or

lirated. Operculum truncate, conoid, concentric, multispiral; internally membranous, externally shelly; external margins of the whorls raised in the form of shelly plates, incurved; sometimes sculptured.

Animal white, with a short oval foot, undivided beneath; tentacles small, black, with eyes at the base.

CYCLOTUS, Guilding.

Syn.—Poteria, Gray.

Distr.—120 sp. Tropical, world-wide. *C. planorbulus*, Lam. (lxxvii, 10).

Shell subdiscoidal, very widely umbilicated; aperture circular, entire; peristome straight or sometimes reflected. Operculum orbicular, calcareous, a little concave exteriorly.

APEROSTOMA, Troschel. Peristome forming a posteriorly projecting angle, not reflected. Operculum with ridged whorls. *C. asperulus*, Sowb.

CYRTOTOMA, Mörch (Adams). Last whorl free, cylindrical; aperture rounded, the left margin dilated, angulated and produced posteriorly. *C. Mexicanus*, Menke (lxxvii, 12).

AMPHICYCLOTUS, Crosse and Fischer. Operculum horny, multispiral, with a central, wart-like projection inside. Type, *C. Boucardi*, Sallé. Mexico.

OPISTHOPHORUS, Benson.

Distr.—16 sp. Siam, Java, Borneo, Sumatra. *O. biciliatus*, Mouss. (lxxvii, 13).

Shell depressed, widely umbilicated; suture with a small open tube; peristome double. Operculum calcareous, rather thick, double, with concamerations between the two disks, which are both concave, the interior one with a corneous epidermis.

MICHOPOMA, Blanford. Shell turbinate; epidermis fuscous, thick, hirsute; aperture corrugate within. Operculum multispiral, calcareous without, corneous within. 2 sp. India. *O. hirsutus*, Beddome (lxxvii, 14).

RHIOSTOMA, Benson.

Etym.—*Rhion*, a promontory.

Distr.—6 sp. Siam, Cochin China. *O. Haughtoni*, Benson (lxxvii, 15).

Shell subdiscoidal, broadly umbilicated; last whorl separate, laterally descending; aperture free, with an incision at the top, and a subtubular prominence crowning the slit. Operculum multispiral.

CYCLOSURUS, Morelet, 1881. Shell with three embryonal spiral whorls, then disjoined and becoming tubular; aperture circular, peristome continuous, simple. Operculum corneous, multispiral.

The separation of the whorls commenced in *Rhiostona*, here becomes very striking. A sufficiently large number of specimens were obtained to show that this is a normal form. *Syn.*—(?) *Orygoceras*, Brusina, 1882. *Distr.*—*C. Mariei*, Morel. (lxxvii, 16). Mayotte Isl. Fossil. Miocene; Dalmatia.

PTEROCYCLOS, Benson.

Syn.—*Steganostoma*, Troschel.

Distr.—26 sp. India, China, East Indies. *P. anguliferus*, Souleyet (lxxvii, 17, 18).

Shell subdiscoidal, widely umbilicated; peristome expanded, produced into a little wing at the suture. Operculum thick, composed of a number of calcareous spiral laminae.

SPIRACULUM, Pearson. Distinguished by the possession of a retroverted sutural tube open at both ends, and by a modification of the form of the mantle corresponding to the same. 5 sp. India. *S. hispidum*, Benson (lxxvii, 19, 20).

DIADEMA, Pease. (*Garrettia*, Pease.) Shell globosely turbinate, umbilicated; peristome continuous, simple, subcircular, free or scarcely adnate. Operculum subcartilaginous, elevately spirally lamellar, concave within, widely reflected at the base. 3 sp. Polynesia. *D. parva*, Pease (lxxvii, 21).

CÆLOPOMA, A. Ad.

Distr.—*C. Japonicum*, A. Ad. (lxxvii, 22, 25). Japan.

Shell subdiscoidal, widely umbilicated; peristome simple, subangulated above. Operculum plate, conical, concave, corneous, spiral.

ALYCÆUS, Gray.

Distr.—54 sp. India, East Indies. *A. gibbus*, Fer. (lxxvii, 23).

Shell conical or depressed; whorls rounded, with profound sutures; last whorl ventricose, strangulated, and tortuous near the rounded aperture; peristome double, the exterior edge reflected. Operculum corneous, multispiral.

HYBOCYSTIS, Benson.

Syn.—*Pollicaria*, Gould (in part).

Distr.—3 sp. Burmah, Siam, Cambodia. *H. gravis*, Benson (lxxvii, 24).

Shell pupiform; peristome continuous, reflected, with a superior process. Operculum multispiral, calcareous, with four or five whorls externally, and one and a half whorls internally.

Family Relations Doubtful.

CHONDRELLA, Pease.

Distr.—3 sp. Central Polynesia. *C. parva*, Pease, Tahiti.

Shell globosely conical, rather thin, striate, imperforate or

rimate: aperture subcircular; peristome simple, thin, margins widely separated; columella callously appressed, widely dilated. Operculum testaceous, smooth and flat externally, the nucleus obsolete, slightly concave and costate within.

Animal without tentacles, the eyes immersed in the top of the head.

FERUSSINA, Grateloup.

Etym.—Named in honor of Baron Ferussac.

Syn.—Strophostoma, Desh.

Distr.—Fossil. Miocene; Europe. *F. tricarinata*, Braun (lxxvii, 36, 27).

Shell oval-globular, or subturbinate; aperture turned upwards and applied to the side of the spire, rounded; peristome continuous; umbilicus open, frequently bordered by a spiral keel.

SCOLIOSTOMA, Braun. Shell turriculated; aperture rounded, turned up upon the spire, entire; lip thick, varicose, reflected, *F. megalostoma*, Sandb. (lxxvii, 50).

THYROPHORELLA, Greef, 1882.

Distr.—*T. Thomensis*, Greef. Island of St. Thomas, W. Coast of Africa.

Shell sinistral, thin, transparent, nearly orbicular, with a slight yellowish epidermis; umbilicated; whorls sharply keeled; aperture half-round, with sharp simple margin; furnished with an operculum, connected or hinged to the shell instead of being a separate growth of the animal—so that the shell is a true terrestrial bivalve; the operculum being pushed open like a door for the exclusion of the animal and shutting upon it when withdrawn; the lines of sculpture of the shell are also continued without break upon the surface of the operculum. Terrestrial.

The animal is not described, although the author states that two of the five specimens obtained contained the soft parts. Not figured.

FAMILY HELICINIDÆ.

Shell turbinated, subglobose or depressed; columella generally very callous; aperture semilunar, with a thick, simple lip; umbilicus covered by the columellar callus. Operculum suboval or subtriangular, testaceous or corneous, mostly lamellar.

Lingual teeth with a single central, flanked on each side by three laterals (xii, 43). Head proboscidiiform; tentacles subulate, with the eyes at their outer bases. Foot elongated.

The tentacles are more slender and produced and the caudal extremity of the foot is more elongate than in the Cyclophoridae; the operculum, moreover, is formed on an entirely different plan, and the aperture of the shell, instead of being circular, is semilunar in outline. In their habits they are very similar to the

animals of the Cyclophoridæ, but are considerably more locomotive and lively; in common with some other mollusks, as the Neritidæ and Ellobiidæ, they possess the faculty of removing the inner septa and columella of the shell.

HELICINA, Lam.

Syn.—Ampullina, Blainv. Pitonillus, Montf.

Distr.—350 sp. West Indies, tropical America, Pacific Islands, Australian Islands, Philippines. *H. variegata*, Orb. (lxxvii, 28).

Shell globose, depressed or keeled, callous beneath; aperture squarish or semilunar; columella flattened; peristome simple, expanded. Operculum shelly or membranous, squarish or semi-ovate, lamellar.

OLIGYRA, Say. Shell subglobular or conic, spine and last whorl of about equal height, peristome expanded. *H. occulta*, Say. United States.

PACHYSTOMA, Swainson. Shell conically depressed, carinated. *H. agglutinans*, Sowb. (lxxvii, 29, 30).

PCENIA, H. and A. Adams. Peristome subdentate interiorly. *H. depressa*, Gray (lxxvii, 31).

IDESA, H. and A. Adams. Peristome simple, sharp. *H. rotunda*, Orb. (lxxvii, 32).

EMODA, H. and A. Adams. Peristome simple, thick, obtuse. *H. festiva*, Sowb. (lxxvii, 33).

PERENNA, Guppy, 1867. Shell depressed, whorls lirate and carinate. Operculum thin, suboval, concentrically striate, nucleus subcentral. *H. lamellosa*, Guppy. Isl. Trinidad.

DAWSONELLA, Bradley. Aperture small, lip thickened within, columella with a wide-spreading linguiform callus covering the axis. Carboniferous; United States. *H. Meeki*, Bradley (lxxvii, 34).

TROCHATELLA, Swainson.

Distr.—34 sp. West Indies. *T. constellata*, Morel. (lxxvii, 35).

Shell trochiform or globular-conic; aperture subtriangular; peristome simple, expanded; base not callous.

VIANA, H. and A. Adams. (Rhynchocheila, Shutt. Hapata, Gray.) Shell subcarinated; lip with a superior sinus. *T. regina*, Morel. (lxxvii, 36).

SCHAZICHEILA, Shuttleworth.

Distr.—5 sp. West Indies, Central America. *S. alata*, Menke (lxxvii, 37, 38).

Shell with spiral epidermal fringes; peristome profoundly incised at the suture. Operculum thin, testaceous, with an intra-marginal rib.

ALCADIA, Gray.

Distr.—28 sp. West Indies. *A. Brownii* (lxxvii, 39).

Shell Helix-shaped, often velvety, callous beneath; columella flattened, straight; peristome slit in front. Operculum shelly, semiovate, with a tooth-like process adapted to the slit in the peristome.

LUCIDELLA, Swainson.

Distr.—5 sp. West Indies. *L. aureola*, Fer. (lxxvii, 40).

Shell depressed, heliciform, slightly callous at the base; aperture triangular, sinuous; peristome thickened, with superior and inferior tooth-like internal laminae. Operculum membranous.

BOURCIERA, Pfeiffer.

Distr.—2 sp. Equador. *B. heliciniiformis*, Pfr. (lxxvii, 41, 42).

Shell heliciniiform, subglobose; aperture oval; peristome expanded, produced at the base. Operculum paucispiral, corneous.

Bourciera absorbs away the inner whorls of the shell, like Helicina; its dentition also agrees with that group.

STOASTOMA, C. B. Adams.

Etym.—*Stoa*, pillared, *stoma*, mouth.

Syn.—Hemicyclostoma, C. B. Ad.

Distr.—83 sp. One in Isle of Opara, Philippines, one in Hayti; all the others in Jamaica. *S. pisum*, C. B. Ad. (lxxvii, 43).

Shell minute, globose-conic or depressed, spirally striated; aperture semioval; peristome continuous; inner margin straight, forming a small spiral keel round the umbilicus. Operculum shelly, lamellar.

ELECTRINA, Gray. Shell smooth. *S. succinea*, Sowb. (lxxvii, 44), is the only species.

WILKINSONÆA, Chitty, 1857. Shell subdiscoidal, spirally carinated, last whorl much produced. *S. Wilkinsonianum*, Chitty.

FADYENIA, Chitty, 1857. Shell with the spire depressed, subangular on the upper part of the last whorl, subplanate at the periphery, subangulated below, and subplanate round the umbilicus. *S. Fadyenianum*, C. B. Ad.

METCALFEIA, Chitty, 1857. Shell depressed conic. *S. Metcalfeianum*, Chitty.

PETITIA, Chitty, 1857. Shell globose, discoid. *S. Petitionum*, C. B. Ad.

LINDSLEYA, Chitty, 1857. Shell globose, conic. *S. Lindsleyanum*, C. B. Ad.

BLANDIA, Chitty, 1857. Shell subdiscoidal. *S. Blandianum*, C. B. Ad.

LEWISIA, Chitty. Shell subdiscoidal; aperture semiovate; peristome continuous, with a spiral callus at the base excessively

developed, usually soldered by its extreme edge to the last whorl, and forming over the umbilicus an arch, having the opening larger than the aperture of the shell. *S. Philippiana*, C. B. Ad. (lxxvii, 45, 46).

PROSERPINA, Guilding.

Syn.—*Odontostoma*, d'Orb.

Distr.—7 sp. West Indies, Northern So. America. *P. depressa*, d'Orb. (lxxvii, 47).

Shell orbicular-depressed, polished, covered at the base by a shining callus; aperture semioval, lip sharp; columella and parietal wall with dentiform lamellæ. No operculum.

PROSERPINELLA, Bland, 1865. Columellar fold absent; having a single parietal tooth. *P. Berendti*, Bld. Mexico.

CYANE, H. Ad., 1870. Columella truncate below. *P. Blandiana*, Ad. Peru.

CERES, Gray.

Distr.—2 sp. Mexico. *C. eolina*, Duclos (lxxvii, 49). Shell heliciform, carinated at the periphery, upper surface rugose, epidermis thin, callous at the base; lip sharp, with spiral laminae within the aperture; columella with dentiform laminae.

ORDER SCUTIBRANCHIATA.

Branchiæ pectinated, placed in a cavity in the upper part of the neck, or at the inferior edge of the mantle, around the foot. Diœcious.

Shell usually spiral (globular or pyramidal) or conical, holostomate.

Suborder *PODOPHTHALMA*. Shell spiral. Operculum usually present and paucispiral or multispiral. Eyes on peduncles, separate from the tentacles.

Suborder *EDRIOPTHALMA*. Shell conical, not spiral; no operculum; eyes sessile.

SUBORDER *PODOPHTHALMA*.

FAMILY NERITIDÆ.

Shell thick, semiglobose, porcellaneous; spire very small; cavity simple, from the absorption of the internal portions of the whorls; aperture semilunate; columellar side expanded and flattened; outer lip acute. Operculum shelly, subspiral, articulated.

At each end of the columella there is an oblong muscular impression, connected on the outer side by a ridge, on which the operculum rests; within this ridge the inner layers of the shell are absorbed.

Animal with a broad, short muzzle, and long slender tentacles; eyes on prominent pedicels, at the outer bases of the tentacles;

foot oblong, triangular. Lingual dentition similar to the Turbinidæ. Teeth 7; uncini very numerous (xii, 44, 45).

NERITA, Linn.

Etym.—*Nerites*, a sea-snail, from Nereis.

Distr.—Over 200 sp. Nearly all warm seas. West Indies, Red Sea, Zanzibar, Philippines, Australia, Central Pacific, West America. Many of the American species dwell in the streams; one species at the Philippines sometimes climbs up trees.

Fossil, 60 sp. Lias—; Britain, etc. The palæozoic *Nerites* are referred by d'Orbigny to *Turbo*, *Natica*, etc.

N. polita, Linn. *N. peleronta*, Linn. *N. histrio*, Linn. *N. undata*, Linn. (lxxviii, 51–54).

Shell thick, smooth or spirally grooved; epidermis horny; outer lip thickened and sometimes denticulated within; columella broad and flat, with its inner edge straight and toothed. Operculum shelly.

Animal with the mantle-margin festooned. Living on rocks and stones, and said to be most active during the night, when they roam about, feeding on the algæ; their eggs are ovate, covered with a horny skin, and attached to other shells.

PELERONTA, Oken. (*Pila*, Klein. *Ritena* and *Tenare*, Gray.) Inner lip rugose, outer lip dentate within. *N. Deshayesii*, Recluz (lxxviii, 55).

THELIOSTYLA, Mörch. (*Natere*, Gray. *Dontostoma*, Klein.) Inner lip granulated or tuberculated. *N. exuvia*, Linn. (lxxviii, 56).

DEIANIRA, Stolicz. Shell subglobose, consisting of few whorls, the last of which is the largest, often carinated posteriorly; aperture large, semilunar; inner lip thick with three folds, the posterior one of which is the strongest. Operculum broadly oval, calcareous, with a tooth on the inner edge, and a groove corresponding to the strong posterior fold of the inner lip. Cret., fresh and brackish water deposits of the N. Eastern Alps. *N. bicarinata*, Stol. (lxxviii, 57, 58).

LISSOCHILUS, Pethö., 1882. Outer lip sharp, not thickened nor dentate within, inner lip not dentate. Triassic and Jurassic. *N. sigaretina*, Buv.

OTOSTOMA, d'Arch., 1859. (? *Lyosoma*, White.) Shell thick, globose; upper part of body-whorl with somewhat curved folds and very fine spiral lines; inner lip callously thickened, toothed; outer lip obliquely truncate, not thickened within. *N. rugosa*, Høeningh. Cretaceous.

DESHAYESIA, Raulin, 1844.

Etym.—Dedicated to M. Deshayes, author of "Description des Animaux sans Vertèbres dans le bassin de Paris," etc.

Syn.—*Naticella*, Grateloup (non Münster). *Oncochilus*, Pethö., 1882.

Distr.—2 sp. Oligocene and Miocene; Paris and Bordeaux basins. *D. Neritoides*, Grat. (lxxviii, 59).

Shell subglobose, thick, umbilicated; spire short; aperture entire, semicircular, oblique; columella oblique; callosity denticulated; umbilicus covered by the callosity; right lip acute, smooth internally.

This genus presents a very remarkable combination of the characters of *Natica* and *Nerita*, and appears to establish a passage between these two genera, types of distinct families.

NERITOPSIS, Grateloup.

Syn.—*Radula*, Gray. *Peltarion*, Desl. *Cyclidia*, Rolle. *Delphinulopsis* (in part), Laube. *Scaphanidia*, Müll. (The last three founded on opercula.)

Distr.—1 recent and 20 fossil sp. Triassic—; Europe. *N. radula*, Linn. (lxxviii, 60–62).

Shell subglobular, neritiform, with the spire a little elevated; columellar lip not dentate, largely excavated or sinused in the middle. The fossil opercula of this genus were, until recently, believed to be the beaks of cephalopods (*Peltarion*).

NERITOMA, Morris.

Distr.—Jurassic; Europe. *N. angulata*, Sowb. (lxxviii, 63).

Shell ventricose, thick; apex eroded; aperture with a notch in the middle of the outer lip; inner lip excavated in the middle, without teeth. Casts of this shell are common, and exhibit the condition of the interior characteristic of all the *Nerites*; it was probably fresh water.

NERIDOMUS, Morris and Lycett. Shell smooth, ovately globose; spire small, oblique; the last whorl very large; aperture ovate or semilunar; outer lip thick, inner lip thick, convex and smooth. Great Oolite; England. *N. hemisphærica*, Römer (lxxviii, 64).

NERITINA, Lam.

Syn.—*Neritella*, Humph. *Lamprostoma*, Swains.

Distr.—140 sp. Tropical and subtropical; West Indies, Europe, India, Philippines, Polynesia, West America. Fossil, 20 sp. Jurassic, Eocene—. *N. communis*, Quoy (lxxviii, 65).

Shell globular, rather thin, aperture-margin thickened; outer lip acute; inner lip straight, denticulated. Operculum shelly with a flexible border; exhibiting two processes which von Martens calls the "rib" and "peg," and in which he has found the characteristics of several groups of minor value. Animal similar to *Nerita*.

Neritina can only be distinguished from *Nerita* by slight differences in the operculum and by the general facies.

The *Neritina* are small, smooth globular shells, ornamented with a great variety of black or purple bands and spots, covered

with a polished horny epidermis. They are mostly confined to the fresh waters of warm regions. One species (*N. fluviatilis*) is found in British rivers, and in the brackish water of the Baltic. Another extends its range into the brackish waters of the North American rivers; and the West Indian *N. viridis* and *meleagris* are found in the sea.

Some are amphibious, clinging to the roots of Nipah palms and other trees on the margins of rivers, while a few inhabit the foliage of tall trees that overhang the waters.

NERITINA (restricted), Swainson. Shell globular or oval-conic, usually brilliantly ornamented with colors; inner lip crenulated, rarely simple. Philippines, etc.

THEODOXUS, Montf. (Vitta [Klein], Adams. Puperita, Gray. Elea, Ziegler.) Shell transverse, smooth or nearly so; inner lip flattened, simple-edged or denticulated. Operculum, peg rudimentary. Inhabits the fresh waters of Europe. Kobelt has divided this group into NERITOGLOBUS, for species of the form of *N. fluviatilis* (lxxviii, 66), and NERITICONUS, for the conical forms, like *N. Mertoniana* (lxxviii, 67).

DOSTIA, Gray. (Mitrula, Menke.) Shell sandal-shaped, solid, the apex completely posterior and a little lateral; peristome continuous and free; inner lip septiform, arcuated and denticulated in the centre of its margin. Brackish water, East Indies. *N. crepidularia*. Lam. (lxxviii, 68).

CLYPEOLUM, Recl. (Neritella [Humph.], Adams.) Shell globular, oval or conic; thin, covered by a corneous epidermis; aperture semilunar; inner lip straight, flattened, smooth or denticulated on the margin; outer lip very full, often produced into a tongue upon the spire posteriorly. Operculum, peg and rib well developed, quite separated from each other. Mostly Polynesian. *N. pulligera*, Linn. (lxxviii, 69, 70).

CLITHON, Montfort. (Corona, Recluz.) Shell coronated with tubercles, or short or long spines, covered with a corneous epidermis; inner lip usually denticulated, presenting frequently a large superior tooth. Operculum with peg and rib both well developed, connected in half their length. The spines that usually ornament the whorls are tubular, and sometimes very long; the Clithons inhabit tropical countries; they crawl slowly, and only show during locomotion the tentacles and the tip of the muzzle; they prefer a stony bottom, clear and free from weeds, where the water is tolerably quiet. *N. longispina* (lxxviii, 71).

NERITONA, Martens. Peg of the operculum depressed, almost flat, lobate at its tip. *N. labiosa*, Sowb. (lxxviii, 72). Fresh water, Polynesia. Too close to Clypeolum.

NERITODRYAS, Martens. Rib of the operculum deeply furrowed, multilobate at the tip, and deeply excavated beneath. Living

on damp foliage above the water. Philippines. *N. cornea* and *N. Philippinarum* are members of this group—which is too close to the typical one.

SMARAGDIA, Issel. (Gaillardotia, Bourg.) Eyes sessile, not stalked. *N. viridis*, Linn. (lxxviii, 73).

NERIPTERON, Lesson. Shell flattened, biauriculated posteriorly; spire posterior, lateral; inner lip septiform, its margin denticulated. Polynesian. *N. vespertina*, Recluz (lxxviii, 74).

ALINA, Recluz. Shell flattened, dilated posteriorly, the upper end of the exterior lip prolonged upon the spire, transversely; inner lip finely denticulated. Scarcely different from Neripteron. Polynesia. *N. latissima*, Brod. (lxxviii, 75).

NAVICELLA, Lam.

Etym.—*Navicella*, a small boat.

Syn.—Catillus, Humph. Cibota, Brown.

Distr.—33 sp. India, Mauritius, Moluccas, Australia, Pacific. *N. apiata*, Guillou (lxxviii, 76.) *N. Janelli*, Recl. (lxxviii, 77).

Shell oblong, smooth, limpet-like; with a posterior, submarginal apex; aperture as large as the shell, with a small columellar shelf, and elongated lateral muscular scars. Operculum very small, shelly, with horny margin, with a lateral apophysis (lxxviii, 78).

Head large; foot attached on each side to the visceral mass, forming a cavity open behind. The operculum is applied to the dorsal side of the foot and is concealed in the cavity which it forms with the visceral mass. The species, which are exclusively East Indian and Polynesian, are usually found on the banks of rivers adhering to floating sticks and to the petioles and roots of the Nipah palms and other plants that live near the rivers; they are also found attached to smooth stones.

SEPTARIA, Fer. Apex submarginal. *N. Entrecasteauxii*, Recluz (lxxviii, 79).

ELARA, H. and A. Adams. Apex a little elevated above the posterior margin, laterally recurved. *N. Lapeyrousei*, Recl. (lxxviii, 80).

Dr. Gray has divided the genus from characters derived mostly from the opercula, partly from the shells: like the smaller groups above noted, these are very unsatisfactory.

CATILLUS, Humph. (= *Navicella*, restricted.) Shell elliptical, mouth wide; inner lip flat, shelving, transverse or slightly regularly arched. Operculum, shelly plate subquadrangular.

ELANA, Gray. Operculum moderate, thin.

LAODIA, Gray. Operculum moderate, as long or longer than broad, thick; upper lobes subequal, obtuse or acute; the right rib indistinct and separated from the margin by a granular space,

which is widest in the middle of the edge; nucleus obscure, punctured.

PARIA, Gray. Shell elliptical, mouth wide; inner lip flat, shelving upwards, produced and truncated in the middle, with a roundish notch on each side near the margin of the cavity. Operculum, shelly plate subquadrangular, lower edge straight, transverse, with a flexible flap, the upper edge with two lobes, the marginal lobe elongate, linear.

STENOPOMA, Gray. Shell elongate; mouth elongate, narrow. Operculum oblong-elongate, the horny part triangular, very oblique, acute near the nucleus, and rounded at the end; shelly plate elongate, thin, with two elongated ridges on the upper end, the marginal one produced into a spine, with a notch on its left margin.

ORTHOPOMA, Gray. Operculum oblong; horny part triangular, rather oblique; shelly plate half oblong, rather narrowed above, and rounded at the upper edge, with a very slight fold diverging from the nucleus to the left upper margin; the anterior cartilaginous flap large, broad. Shell unknown.

The characters of all these divisions so run together through a series of specimens that they may be regarded as practically worthless.

VELATES, Montfort.

Distr.—Tertiary. *V. perversa*, Linn. (lxxviii, 81, 82).

Shell oval-conic, spiral at the apex only; last whorl greatly enlarged, resembling Trochita in shape; aperture basal, semi-circular, forming with the wide flat, shelf-like columellar lip a circular outline; columellar lip dentate.

VELATELLA, Meek, 1878. Cretaceous and Laramie; United States. *V. carditoides*, Meek (lxxviii, 85, 86).

PILEOLUS (Cookson), J. Sowerby.

Etym.—*Pileolus*, a little cap.

Distr.—Marine; only known as fossils.

Shell limpet-like above, with a subcentral apex; concave beneath, with a small semilunar aperture, and a columellar disk, surrounded by a broad, continuous peristome.

The secondary species have the basis generally rounded and the apex subcentral, while the tertiary species have it more oval and the apex terminal; to the latter, approaching more nearly the recent Navicellæ, Deshayes applies the subgeneric name **TOMOSTOMA**. *P. radiatus*, d'Orb. (lxxviii, 83, 84).

FAMILY LIOTIIDÆ.

Shell depressed spiral, white, ribbed, sometimes cancellate, or nodulous; aperture orbicular, rarely pearly within. Operculum corneous inside, outside having a calcareous coat formed of separate, pearl-like, shelly particles placed in spiral lines.

The animal differs from that of Turbo by the absence of lobes between the tentacles, but appendages are present on the outer side of these; median head-lobes are, however, known in Cyclostrema, the animal of which rather resembles that of Scissurella; the body is cylindrical, tentacles either thick and short or thin and prolonged; foot small, with short appendages, head produced, eyes on conspicuously thickened bulgings.

LIOTIA, Gray.

Distr.—Tropical and subtropical. Fossil. Jurassic—. *L. scalaroides*, Reeve (lxxix, 87).

Shell turbinated or depressed, varicose, perforated or umbilicated; whorls ribbed or cancellated; aperture rounded, pearly within; peristome thick, callously margined.

ARENE, H. and A. Adams. Whorls muricated, the last subspinous or angulated; peritreme more or less angular. *L. australis*, Kiener (lxxix, 88).

CYCLOSTREMA, Marryat.

Syn.—Delphinoidea, Brown. Lippistes, Montf.

Distr.—23 sp. Mostly Japan and Philippines; Europe, Australia, West Indies. *C. cancellata*, Marryat (lxxix, 89). Fossil. Tertiary.

Shell orbicular, depressed, widely umbilicated, spire short; whorls transversely striated or cancellated; aperture round, not nacreous; peristome continuous, simple.

Animal. Eye-peduncles very short; tentacles ciliated; foot with long, curved, linear auricles in front, the sides with three ciliated filaments.

CYNISCUS, H. and A. Adams. Umbilicus surrounded by a spiral callosity; whorls ornamented by transverse granose ribs; outer lip rather thick, subcrenulated, prolonged posteriorly upon the penultimate whorl. *C. granulata*, A. Ad.

MÖLLERIA, Jeffreys. Shell remarkably solid, with strong and partly dichotomous transverse ribs; peristome continuous. Operculum calcareous, multispiral. Foot furnished with filaments. *M. costulata*, Möller. Europe.

DARONIA, A. Ad. Shell orbicular, discoidal, evolute, spire depressly concave; whorls rounded, more or less disunited; aperture circular, peritreme continuous. Philippines, Japan. *C. spirula*, A. Ad. (lxxix, 90).

TUBIOLA, A. Ad. Shell subevolute or loosely enroled; whorls rounded, simple, concentrically striated; aperture subcircular; peritreme continuous, margin acute, entire. Two Japanese and one British species (*Skenea divisa*). *C. nivea*, Chemn. (lxxix, 91).

MICROTHERCA, A. Ad. Shell globosely turbinate, widely umbilicate, somewhat porcellaneous; radiately, rugosely plicate; sutures channeled: whorls crenulate at the sutures; aperture semicircu-

lar; peritreme continuous, inner lip thickened and arcuate, outer lip with the margin thickened; umbilicus crenulate. Japan. *C. crenellifera*, A. Ad. (lxxix, 92).

MÖRCHIA, A. Ad. Shell obliquely ovate, depressed, widely umbilicated, convex above, flat beneath; whorls rapidly increasing, the last dilated, ascending and embracing the other whorls as far as the apex; aperture oblong, oblique, somewhat horizontal, dilated below, narrowed above; peritreme continuous, thickened. Japan. *C. obvoluta*, A. Ad. (lxxix, 93).

CIRSONELLA, Angas. Shell minute, globosely turbate, smooth, narrowly umbilicated; aperture circular, peritreme continuous, slightly thickened. *C. australis*, Angas (lxxix, 94).

DISCOPSIS, Folin. Shell discoidal, depressed, umbilicated; margins of the oblique aperture canalicularly joined upon the penultimate whorl. 2 sp. W. Africa.

FAMILY ROTELLIDÆ.

Shell more or less lenticular, polished; umbilical region covered by a large, convex, subvitreous callus. Operculum thin, corneous, ciliated on the outer edge; animal with rudimentary rostrum; frontal lobes greatly developed.

ROTELLA, Lam.

Etym.—Diminutive of *rota*, a wheel.

Syn.—Globulus, Schum. Umbonium, Link.

Distr.—20 sp. India, China, Japan, Philippines, N. Zealand. *R. Zelandica* (lxxix, 95, 96). Fossil. Devonian—.

Shell depressed, lenticular, the spire depressed conical; aperture semiorbicular, outer lip sharp; base with a convex, rounded umbilical carina.

Animal. The lateral fringe of the foot is distinct, with three tentacular filaments on each side; at the front of the right side, near the base of the tentacles, it is produced into an oblong, fleshy lobe. The right tentacle is the larger and free, with an oblong, compressed lobe on its hinder side which has an indistinct indication of an eye; the left tentacle is smaller and partly attached to the upper side of the left eye-pedicel, which is cylindrical, bearing a very distinct eye, and furnished with a large, membranous expansion attached to the whole of its length on its left side, and which is fringed at the edge. This frontal appendage, when the animal is alive, is folded on itself to form a tube, which has caused it to be mistaken for a siphon.

ETHALIA, H. and A. Adams. (*Pseudorotella*, Fischer.) Whorls convex, smooth or transversely striated; columellar lip terminating anteriorly in a callosity. Scarcely differing from the typical group. *R. Guamense*, Quoy (lxxix, 97).

HAPLOCOCHLIAS, Carpenter. Shell like *Collonia*, but not pearly;

aperture circular, varicose; columella not callous. Animal and operculum unknown. Its affinities may be with *Ethalia*. *R. cyclophoreus*, Carp. Cape St. Lucas.

PARKERIA, Gabb. (After C. F. Parker, curator of the Philada. Academy.) Shell minute, in form like *Rotella*, but with the shell-substance vitreous and transparent or translucent like *Vitrinella*; inner lip thickened, and the umbilicus covered with a not very heavy callus as in *Rotella*. Miocene; W. Indies. 1 recent species. *R. vitrea*, Gabb (lxxix, 98).

TURBINA, de Koninck, 1881.

Distr.—4 sp. Carboniferous; Europe. *T. deornatus*, Kon.

Shell top-shaped, thin and fragile, smooth; spire of 5–8 convex whorls; mouth large, transversely rounded, the margin sharp, not thickened, columella not twisted; umbilicus narrow and deep, sometimes wanting.

PLCOSTYLUS, Gemmellaro, 1878.

Distr.—Liassic, Jurassic; Italy. *P. typus*, Gemm.

Shell top-shaped, thick, smooth; spire obtuse; whorls rapidly enlarging, the last very large, rounded; base more or less flattened; mouth round; inner lip straight, short, ending in an anterior fold, forming a tubercle; outer lip obtuse.

TEINOSTOMA, H. and A. Adams.

Distr.—8 sp. Philippines; Japan, Mazatlan. *T. politum*, A. Ad. (lxxix, 99).

Shell orbicular, depressed, subspiral, polished or spirally striated, last whorl rounded, or angulated at the periphery; umbilical region covered with a large, flat callosity; aperture transverse; inner lip smooth, callous; outer lip thin, simple, not margined or reflected.

CALCEOLINA, A. Ad. Shell neritiform, oblong, depressed; spire small; whorls rapidly increasing, umbilical region callous; aperture semicircular; inner lip with a large wide callus, covering posteriorly the umbilicus; margin of the callus straight, simple. Japan. *T. pusilla*, Ads. (lxxix, 100).

[**CYCLORA**, Hall.

Distr.—*C. minuta*, Hall. Palæozoic; Ohio.

Subglobose, thin, small, spire short, consisting of a few whorls; columella smooth, slightly reflected over a minute umbilicus; aperture circular. See p. 223.]

ANOMPHALUS, Meek and Worthen.

Distr.—*A. rotulus*, Meek and Worthen (lxxix, 1). Carboniferous; Ills.

Shell depressed, sublenticular, imperforate, smooth, volutions

somewhat embracing above, and each hiding all the preceding ones below; aperture wider than high; peristome not continuous; labrum simple, projecting forward above; labium a little sinuous and slightly spreading in the more or less impressed umbilical region.

PITONELLUS, Montfort.

Syn.—Ptychomphalus, Agassiz. Lewisiella, Stolicz.

Distr.—Lias, Cretaceous; Europe. *P. archiacianus*, d'Orb. (lxxix, 2). *P. conicus*, d'Orb. (lxxix, 3).

Shell depressed or conic, whorls generally rounded, the base with a very strong shining callus; lip simple, sharp.

CROSSOSTOMA, Morris and Lycett.

Distr.—2 sp. Oolite; England. *C. Prattii*, Morris and Lycett (lxxix, 4).

Shell thick, depressed turbinated, without umbilicus; aperture subrotund, entire; outer lip smooth; columella toothed when young, tooth concealed by callus in the adult.

TROCHOPSIS, Gemmellaro, 1878. Shell top-shaped, thick, shining, imperforate; outer lip with four inferior tuberculate spiral ribs; inner lip curved, sharply defined by a furrow. *C. Moroi*, Gemm. Liassic.

PTEROCHEILOS, Moore.

Distr.—*Pt. primus* (lxxix, 5). Liassic; England.

Very thick, small, with the general contour angulated or rhomboidal, smooth, spire short, periphery of last whorl carinated, the carina terminating in a wing-like projection of the outer lip; aperture with a thick, circular peristome, columella thick, folded, subumbilicated, greatly extending beyond the peristome, and possessing a wide but shallow sulcus towards its base.

PLEURATELLA, Moore, 1867.

Distr.—*P. prima*, Moore. Lias; Europe.

Shell small, thick, smooth; spire much depressed; whorls 4-5, rapidly enlarging; last whorl very large, rounded; aperture round or oval; inner lip straight, with thick lengthened columella, having an umbilicus-like groove.

FAMILY PHASIANELLIDÆ.

Shell bulimiform, smooth, polished, richly ornamented with bright colors, without epidermis. Operculum oval, calcareous.

Animal with long ciliated tentacles; head-lobes pectinated, wanting in the minute species; neck-lobes fringed; sides ornamented with three cirri; branchial plume long, partly free; foot rounded in front, pointed behind.

Distinguished from the Turbinidæ by the form of the shell.

from the elongated species of Trochidæ by the calcareous operculum.

PHASIANELLA, Lam.

Pheasant-shell.

Distr.—25 sp. Australia, large species; India, Philippines, small species; Mediterranean, Britain, West Indies, very small species. Fossil, 70 sp. Devonian—; Europe. *P. bulimoides*, Lam. (lxxix, 6).

Shell elongated, polished, richly colored; whorls convex; aperture oval, not pearly; inner lip callous, outer thin. Operculum shelly, callous outside, subspiral inside.

When the animals of this genus crawl, the foot appears to be divided longitudinally into halves, which advance alternately; when the right side moves, the left remains stationary, and when this in turn is carried forward, the other half remains as a point of support; it may be compared to the amble or canter of a horse. In *Phasianella* proper, the tentacles are ciliated, the head-lobes fringed, and the sides of the foot furnished with three cirri. In the smaller species, forming the *Tricolia* of Risso, the head-lobes appear to be wanting. The larger species, all of which have beautifully variegated shells, are principally from Australia, and the smaller ones from the Mediterranean, West Indies and South Africa.

TRICOLIA, Risso. (*Eudora*, Leach.) Shell thin, spire elevated, apex mammillated; suture profound; aperture oval. Small species, Mediterranean, etc. *P. Niciensis*, Risso (lxxix, 7). *P. pulla*, Linn. (lxxix, 8).

LEIOPYRGA, A. Ad. Shell turbinate, thin, smooth, polished; aperture semicircular, shorter than the spire, inner lip thin, columella incurved, excavated. *P. picturata*, A. Ad.

EUCOSMIA, Carp. Shell small, turbinate, solid, smooth, variegated, not nacreous; aperture with the margins nearly continuous, but not callous; columella slightly excavated; axis umbilicated. 6 sp. West Coast of N. America. *P. variegata*, Carp.

ALCYNA, A. Adams.

Distr.—2 sp. Japan. *A. rubra*, Pease.

Shell acuminate ovate, imperforate, spire short, conical, acute; whorls flat, smooth; aperture oval; inner lip callous, terminating in a strong tooth below; outer lip acute, smooth within.

CHROMOTIS, A. Ad.

Distr.—*Phas. neritina*, Dunker (lxxix, 9). Cape of Good Hope.

Shell ear-shaped, thin, polished; spire very short; whorls few, rapidly enlarging; aperture oval, columella flattened and solid. Operculum calcareous.

FAMILY TURBINIDÆ.

Shell spiral, turbinated, nacreous inside. Operculum calcareous, paucispiral.

Animal. Tongue elongate, median teeth broad, laterals five, denticulated, uncini very numerous, slender, with hooked points (xii, 47). Head proboscidiiform; tentacles subulate, sometimes ciliated; eyes on free peduncles at their outer bases; two more or less developed head-lobes between the tentacles. Gill single, long and linear. Sides of the foot with a large neck-lappet near the eye-peduncle, continuous with a conspicuous side-membrane, bearing on its free margin from three to five tapering filaments; operculigerous lobe often ornamented with cirri. Littoral and herbivorous, characterized by the fringed lobes and tentacular cirri of the head and sides, their pedunculated eyes, and by the pearly nature of their shells beneath the epidermis and outer layer. They are invariably marine, feeding on the sea-weeds which abound along the shore, and are distributed in all parts of the globe, being most numerous and of larger growth and more beautiful colors in tropical seas.

The Turbinidæ are distinguished from the Trochidæ generally by the form of the shell, and by the operculum, which is calcareous and paucispiral in the former, corneous and multispiral in the latter. The arrangement of the groups of both families corresponds with that proposed by Dr. Paul Fischer in his excellent monographies of Trochus and Turbo.

TURBO, Linn.

Top-shell. *Etym.*—*Turbo*, a whipping top.

Distr.—76 recent sp. World-wide in tropical seas. Fossil, 400 sp. L. Silurian—; universally distributed. *T. marmoratus*, Linn. (lxxix, 10).

Shell turbinated, solid; whorls convex, smooth or often grooved or tuberculated; aperture large, rounded, slightly produced in front. Operculum shelly and solid, callous outside, and smooth, or variously grooved and mammillated, internally horny and paucispiral. In *T. sarmaticus* the exterior of the operculum is botryoidal, like some of the tufaceous deposits of petrifying wells.

TURBO (restricted). Shell smooth, or tuberculate, covered by a smooth epidermis; inner lip flattened, more or less produced in front; no umbilicus. Operculum spiral on its inner face, convex and smooth or granular (not ridged) externally. 17 sp. Indian and Pacific Oceans, W. Indies.

The "green snail" of the dealers, the *Turbo marmoratus*, is very largely used for ornamental purposes. Slices of this shell ground down to a thin surface, are employed for covering or inlaying various articles, such as small stamp-cases, fancy boxes,

etc., as well as for buttons, earrings, buckles, etc. The light-greenish iridescent play of color of this shell is more ornamental than that of the ordinary white mother-of-pearl. Fine large shells of this species formed the drinking goblets of the Scandinavian monarchs, and are often still met with, very elegantly mounted and set with jewels. The Turk's cap (*T. sarmaticus*) is less extensively used for similar purposes.—SIMMONDS, *Commercial Products of the Sea*, 293.

SARMATICUS, Gray. (*Cidaris*, Swains.) Shell nodulous. Differs from *Turbo* principally in having a black layer between the outer opaque and inner pearly layers of the shell; it forms a dark zone between the edges of the two coats just within the aperture, and is frequently exposed on the upper part of the columella by absorption of the outer layer. Australia, New Zealand.

SENECTUS, Humph. Shell solid, with revolving, squamose or spinose ridges covering the whorls; axis usually narrowly perforated; aperture usually slightly produced in front, with sometimes a short channel. 25 sp. Indian and Pacific O., West Indies. *T. margaritaceus*, Reeve (lxxxix, 11).

OCANA, Adams. Shell turbinate, solid, smooth; axis imperforate; spire short, conical; aperture subcircular, wider than long; inner lip flattened, excavated, scarcely produced anteriorly, with an extended thin callus. Operculum with a convex, granular spiral rib, axis deeply perforated, outer edge simple. *T. cidaris*, Gmelin (lxxx, 19). Cape of Good Hope.

MARMOROSTOMA, Swains. (*Lunella*, Bolt.) Shell thick, smooth or tuberculate; aperture produced in front; columellar callus covering the axis, which is umbilicated, however; the umbilicus often at the upper end of a curved channel in the callus. Operculum spiral, with central nucleus, and an indistinct, subcentral, external rib. 5 sp. Ind. and Pacific Oceans. *T. coronatus*, Gmel. (lxxx, 20, 21).

MODELIA, Gray. Shell rather thin, granular. Operculum granulous externally, with a semicircular ridge on the edge. Australia, N. Zealand. *T. rubicundus*, Reeve (lxxx, 27).

AMYXA, Troschel. (*Prisogaster*, Mörch.) Shell solid, turbinated with elevated spire; whorls with revolving riblets; aperture rounded; inner lip sillonated; outer lip black-bordered and subcrenulated within. Operculum as in *Modelia*. The animal of this subgenus, figured by d'Orbigny, appears to be furnished with a single, elongated, posterior filament, numerous shorter, anterior, tentacular filaments on the lateral membrane of the foot, and two conspicuous cirri on the sides of the opercular lobe. 2 sp. West Coast of tropical America. *T. niger*, Gray (lxxx, 28).

CALLOPOMA, Gray. Shell turbinated-elevated, not umbilicated; whorls angulated or nodulous; aperture rounded, produced in front; inner lip wide, sillonated. Operculum with a spiral central

rib, and several smaller marginal ribs. 4 sp. W. Coast of America, China, Japan. *T. fluctuatus*, Gray (lxxx, 29).

NINELLA, Gray. Shell turbinated, depressed, rugose, tuberculated, umbilicated; internal lip wide, concave, with a longitudinal nacreous excavation near the columella. Operculum with two parallel spiral ribs. Australia, New Zealand. *T. torquatus*, Gmel. (lxxx, 22).

COLLONIA, Gray. Shell small, thick, turbinated, with revolving ribs or smooth, not umbilicated. Operculum with gradually enlarging whorls, a convex external rib and a central pit. Recent and tertiary. *T. sanguineus*, Linn. (lxxix, 12).

ANADEMA, H. and A. Adams. Shell conoidal-depressed, whorls with revolving series of granules; umbilicus with a spiral callus, which enlarges and joins the outer lip; columella terminating anteriorly in one or two tubercles. *T. MacAndrewi*, Mörch (lxxix, 13).

The following genera, recently described by de Koninck, might be referred, with perhaps equal propriety, to other groups.

TURBONILLINA, de Koninck, 1881.

Distr.—Devonian, Carb.; Europe. *T. lepidus*, de Kon.

Shell small, depressed orbicular; umbilicus funnel-like; spire short; whorls convex, finely spirally ribbed; mouth oval, inner lip not thickened.

PORTLOCKIA, de Koninck, 1881.

Distr.—10 sp. Devon. to Carb.; Eur. *P. parallela*, Phil.

Turbiniform, imperforate; spire somewhat elevated; whorls convex, with fine spiral ribs, some becoming stronger on the last whorl; mouth oval, inner lip arched, not thickened.

ACCLISINA, de Koninck, 1881.

Syn.—Turbonilla, Geinitz.

Distr.—*A. (Murchisonia) striatula*, Kon. Carb.

Small, lengthened-conical, imperforate; whorls convex, spirally striate; mouth oval, outer lip sharp, columella slightly thickened, not arched.

? PITHODEA, de Koninck, 1881.

Distr.—2 sp. Carb.; Belgium.

Shell large, thin, ovate, imperforate; whorls rapidly increasing, somewhat dissimilarly, spirally ribbed, with a median smooth, transversely striated band; mouth large, ovate.

TURBONILOPSIS, de Koninck, 1881.

Distr.—2 sp. Carb.; Europe.

Small, depressed, smooth, umbilicated; umbilicus surrounded by a callous thickening.

TURBONITELLA, de Koninck, 1881.

Distr.—Devon. to Carb.; Europe. *T. biserialis*, de Kon.

Shell turbiniform, with convex, smooth or nodulous whorls; mouth round or oval, inner lip callously thickened, outer lip sharp, thin; a narrow umbilical slit.

RHABDOPLEURA, de Koninck.

Distr.—*Monodonta solida*, Kon. Carb.

Conical, height and diameter about equal; whorls 4–5, slightly convex, rapidly enlarging, the last more than half the total length, striate, and finely spirally ribbed; aperture transversely rounded; inner lip somewhat callous, curved and thickened below.

ONKOSPIRA, Zittel.

Distr.—*O. ranellatus*, Quenst. Coral Rag.

Shell thin, lengthened-trochiform, spire pointed; whorls convex, spirally ribbed, keeled or clathrate with one or two varices, which are continuous, as in *Ranella*; mouth rounded-ovate; columella forming an angle with the thickened outer lip.

HAMUSINA, Gemmellaro.

Distr.—Lias; Europe. *H. Bertheloti*, d'Orb.

Shell thin, conical-turreted, sinistral, tuberculate, imperforate; spire sharp; body-whorl angular; aperture rounded, inner lip callous.

PLATYACRA, v. Ammon, 1882.

Distr.—Rhætian; Bavaria. *P. impressa*, Schafh.

Shell thin, turreted, sinistral, widely and deeply umbilicate; whorls with a nodulous keel; apex flattened.

IMPERATOR, Montfort.

Syn.—*Astraliun*, Link. *Tubicanthus*, Sw. *Canthorbis*, Sw. *Hercoles*, Montf.

Distr.—50 sp. East and West Indies, W. America, Australia. Fossil. Trias—.

Shell trochiform, depressed conic; whorls rugose or spinous, the latter especially at the sharply angulated periphery of the last whorl; aperture subquadrangular, subtruncated in front. Operculum calcareous.

IMPERATOR (restricted). Umbilicated. Operculum with a subcentral tubercle and a spiral submarginal rib. *I. longispina*, Lam. (lxxx, 23, 24).

CALCAR, Mont. (*Stella*, Klein. *Cyclocantha*, Swains. *Astrea*, Bolt. *Turboidea*, Seeley.) Not umbilicated; spire more elevated. Operculum externally subspiral, and with a central pit. W. Indies, Indian Ocean. *I. stellaris*, Gmel. (lxxx, 25).

GUILFORDIA, Gray. Periphery with long spines; whorls granose.

subumbilicated, the umbilical region callous. Operculum flattened, with a depressed marginal line. East Indies. *I. triumphans*, Phil. (lxxx, 26).

UVANILLA, Gray. Shell trochiform, conical, with moderately elevated spire; base concave, not umbilicated; whorls flattened, rugose, spinously fringed. Operculum with two convex ribs, one nearly parallel to the margin, the other arcuated, subcentral. 5 sp. Australian seas.... *I. fimbriata*, Lam. (lxxx, 30).

PACHYPOMA, Gray. Like Uvanilla, but base of the shell more concave. Operculum oval, subquadrangular, externally convex. 7 sp. West Indies, Brazil. *I. cœlata*, Chemn. (lxxx, 31).

LITHOPOMA, Gray. Shell turbinated, not umbilicated, spire moderate, whorls with oblique longitudinal ribs and nodules; inner lip concave, subtruncated in front, and with a longitudinal shallow channel. Operculum oval, thick, granulous externally, and flattened at the margins. West Indies. *I. tuber*, Linn. (lxxx, 32.)

POMAULEX, Gray. Shell trochiform, elevated conic, angulated and nodose at the periphery, obliquely ribbed, not umbilicated; inner lip arcuated, with a wide callus, which is channeled, anteriorly truncated. Operculum with three radiating ribs and perforated axis. 7 sp. North Pacific, America and Japan. *I. undosa*, Wood (lxxx, 33).

COOKIA, Lesson. Shell turbinated, not umbilicated; whorls nodulous; columellar lip with a wide flattened callus and spiral shallow excavation. Operculum oval, flat, smooth, with a large subspiral, submarginal rib. New Zealand. *I. Cookii*, Chemn. (lxxx, 34).

BOLMA, Risso. (Tubicanthus, Swin.) Shell turbinated, not umbilicated, rugose or tuberculated, with deep suture; aperture round; inner lip wide, callous, concave. Operculum with a subcentral tubercle and spiral rib. 3 sp. Mediterranean Sea, China, Japan. *I. rugosa*, Linn. (lxxx, 35).

FAMILY TROCHIDÆ.

Shell usually conical, with flattened base, nacreous inside. Operculum corneous, multispiral.

Animal like that of Turbinidæ (p. 304). Differs from that family in its conical shell (usually) and its operculum; that of Turbinidæ being calcareous and paucispiral. Dentition (xii, 46).

DELPHINULA, Lam.

Etym.—Diminutive of *Delphinus*, a dolphin.

Syn.—Angaria, Bolten.

Distr.—20 sp. Eastern tropical seas. *D. melacantha* (lxxx, 36). Fossil. Jurassic—

Shell orbicular, depressed; whorls few, angulated, rugose, or

spiny; aperture round, pearly; peristome continuous; umbilicus open. Operculum horny, many-whorled. On reefs at low-water.

Animal without head-lobes; sides lobed and ciliated.

ANGARINA, Bayle. (*Delphinulopsis*, Wright.) Shell sinistral, discoidal, umbilicate, spirally ridged, last whorl crowned with spines; aperture rounded, nacreous within, columellar margin not nacreous. *D. Lesourdi*, Wright (lxxx, 37).

CIRRUS, Sowb. (In part, not Orb. *Scævola*, Gemm.) Shell sinistral, conical, widely and deeply umbilicated; spire conical, sharp; whorls crossed by longitudinal, nodulous ribs. Liassic. *D. nodosa*, Sowb. England. Sowerby's genus *Cirrus* contained, besides the above, a *Euomphalus* and a *Pleurotomaria*.

LAXISPIRA, Gabb.

Distr.—*L. lumbricalis*, Gabb (lxxix, 14'. Cretaceous; New Jersey.

Shell spiral, dextral, partially unwound and the whorls not in contact; aperture simple, lips thin.

This group is perhaps more nearly related to *Vermetidæ*. At first sight it appears not unlike *Delphinula laxa*, Say, but the latter is a fossil (*Caprotinid*) bivalve.

[TROCHONEMA, Salter, 1859.

Syn.—*Trochonemopsis*, Meek.

Distr.—*T. tricarinata*, Meek (lxxx, 38). Devon.; Ohio.

Has been proposed for a *Delphinula*-like shell with wide umbilicus; it occurs in the palæozoic formations of Europe and North America, and, as in so many other ancient groups, embraces a number of widely different forms. Professor Meek (MSS.) was disposed to place the genus near *Delphinula*.]

TROCHUS, Linn.

Etmy.—*Trochus*, a hoop.

Distr.—250 sp. World-wide. Low-water to 15 fathoms; the smaller species range nearly to 100 fathoms.

Fossil, 360 sp. Devonian—; Europe, North America, Chili.

Shell pyramidal, with nearly a flat base; whorls numerous, flat, variously striated; aperture oblique, rhombic, pearly inside; columella twisted, slightly truncated; outer lip thin. Operculum horny, multispiral.

Animal with two small or obsolete head-lobes between the tentacles; neck-lappets large; sides ornamented with lobes, and 3–5 cirri; gill very long, linear; lingual teeth 11, denticulated; uncini 90, diminishing outwards.

TROCHUS (restricted). Umbilical region excavated, but not perforated; columella spirally twisted above, terminating in a

point anteriorly. 2 sp. Indo-Pacific. *T. Niloticus*, Linn. (lxxx, 39).

ROCHIA, Gray. Shell with a strong fold on the pillar-lip, and a deep sinus behind, near the whorl. *T. acutangulus*, Chemn. Philippines, Australia.

CARDINALIA, Gray. Conical, whorls flattened, granulated, the last angular, not umbilicated; columella simple above, a little twisted, and terminating in a point below; outer lip slightly toothed basally. *T. virgatus*, Gmel. (lxxxi, 40). Indian Ocean, Philippines.

TECTUS, Montfort. (Pyramis, Schum., 1817. Pyramidæa, Swains.) Shell conical, not umbilicated; whorls smooth or tuberculated, the last angular; aperture wider than long; columella short, spirally twisted, terminating in a point anteriorly. 9 sp. Red Sea, Indo-Pacific. *T. triserialis*, Lam. (lxxxi, 41).

POLYDONTA, Schum., 1817. (Lamprostoma, Swains.) Shell conical, not umbilicated; whorls mostly granular, the last angulated; aperture subrhomboidal; columella spirally twisted, rib-like and plicate, forming a false umbilicus; base of aperture rib-like and dentated, joining the columellar dentitions. 17 sp. Indo-Pacific, Polynesia. *T. maculatus*, Linn. (lxxxi, 42).

PRÆCIA, Gray. Shell with the pillar-lip twisted, simple; axial cavity deep, narrow, with a distinct, narrow, central, spiral rib. *T. elegantulus*, Wood, is the only species.

ANTHORA, Gray. Shell with the pillar-lip twisted, simple; axial cavity moderate, narrow, with several opaque, subspiral ridges. *T. viridis*, Gmel.

BELANGERIA, Fisher. No diagnosis published. *T. scabrosus*, Phil. (lxxix, 15). Indian Ocean.

INFUNDIBULUM, Montfort. (Carinidea, Swains.) Shell conical; whorls flattened, the last angular, base concave; columella without teeth or with the teeth obsolete. 6 sp. Indo-Pacific, Red Sea. *T. concavus*, Linn.

OMPHALIUS, Phil. Shell convex-trochiform, umbilicated; whorls with revolving series of granules, the last whorl bluntly angulated at the periphery; umbilicus encircled by a callosity; columellar lip terminated by a tooth anteriorly, below which are small tubercles; outer lip usually internally grooved. 11 sp. East and West tropical America, West Indies. *T. viridulus*, Gmel.

ISANDRA, H. and A. Adams. (Eudora, Ad.) Shell polished, subconoidal, whorls rounded; aperture subquadrangular; inner lip straight, dentate below, forming an angle at its basal union with the outer lip; umbilicus open, profound, surrounded with crenulations. Australia and Philippines. *T. coronatus*, A. Ad. (lxxix, 16).

LIVONA, Gray. (Cittarium, Phil. Meleagris, Montf.) Shell

turbiniiform, solid, smooth, umbilicated; umbilical region strongly callous; aperture rounded, outer lip thin. Animal: lateral membrane of the foot with numerous compound appendages. W. Indies. *T. pica*, Linn. (lxxxix, 47).

TEGULA, Lesson. Shell conical, spire pointed, with revolving granulated ribs; columella spirally twisted, terminating anteriorly in a large obtuse tubercle. 2 sp. W. tropical America. *T. pellis-serpentis*, Wood (lxxxix, 43).

CHLOROSTOMA, Swains. Shell conoidal, profoundly umbilicated, or umbilical region covered by a callosity; whorls smooth or subcarinated, the last subangulated at the base; columellar lip spirally twisted around the umbilicus; outer lip angulated at the base and sometimes presenting one or two tubercles. 16 sp. W. North America, Japan, China. *T. argyrostomus*, Chemn. (lxxxix, 44).

CÆLOTROCHUS, Fischer. Uncharacterized. *T. tiaratus*, Quoy. New Zealand.

EURYTROCHUS, Fischer, 1880. Uncharacterized. 4 sp. Australia, N. Caledonia. *T. Lehmanni*, Menke.

MINOLIA, A. Adams. (*Etym.*—*Mino-Sina*, a Japanese island.) Shell globosely conoidal, widely and profoundly umbilicated; whorls rounded, clathrate, suture canaliculate; last whorl subsolute towards the aperture; umbilicus perspective; aperture circular, pearly within; peristome continuous, thin, acute. *Distr.*—5 sp. Australia, New Caledonia, Japan. *T. dianthus*, Fischer. (lxxxix, 45).

MONILEA, Swains. (Talopia, Gray.) Shell orbicular, depressed, widely umbilicated; whorls encircled by grooves, the last rounded; umbilicus encircled by a striated callus; columella terminating anteriorly in one or two tubercles. 5 sp. Pacific, Australia, New Caledonia. *T. calyculus*, Wood.

LEIOTROCHUS, Conrad. Polished, entire, without umbilicus; base of columella with two denticles. 4 sp. Miocene; U. S. *T. distans*, Conr. Described as a subgenus of Monilea.

SOLANDERIA, Fischer. Uncharacterized. New Caledonia. *T. nucleus*, Phil.

GIBBULA, Risso. (Phorcus, Risso. Steromphala, Leach.) Shell conoidal, umbilicated; umbilicus cylindrical or infundibuliform; whorls frequently tuberculated above and with channeled suture; columella sometimes terminating in a tubercular tooth. 26 sp. Tropical, world-wide. *T. magus*, Linn. (lxxxix, 46).

KORENIA, Friele. Separated from Gibbula on account of slightly different lingual dentition. European.

PRIOTROCHUS, Fischer. (Aphanotrochus, Martens.) Shell like Gibbula, but pillar-lip denticulated. 2 sp. Indian Ocean. *T. obscurus*, Wood (lxxxix, 50).

FORSKALIA, H. and A. Adams. Shell babylonian with elevated

spire and deep sutures; whorls angulated at the periphery, where they are sulcated. 4 sp. Red Sea. *T. fanulum*, Gmel. (lxxxix, 81).

LEPTOTHYRA, Carp. (Leptonyx, Carp. and Ads. Homalopoma, Carp.) Shell small, turbinated, thick, not umbilicated; aperture circular, slightly angulated anteriorly. The type of this group is the California shell identified as conspecific with the Mediterranean species *Turbo sanguineus*, Linn.; the latter, however, has a calcareous operculum, and is therefore a true Turbo, whilst the operculum of this is corneous, multispiral.

CALLIOTROCHUS, Fischer. Uncharacterized. *T. phasianellus*, Desh.

ZIZYPHINUS, Gray. (Calliostoma, Swains. Conulus, Nardo.) Shell trochiform, conical, not umbilicated; last whorl angulated and usually ribbed at the periphery; aperture quadrangular; columella simple, oblique, often ending in a tooth in front. 28 sp. Universally distributed. *T. zizyphinus*, Linn. (lxxxix, 48, 49).

EUTROCHUS, Ad. Zizyphinus-like shells, but umbilicated, the umbilicus encircled by a carina. 3 sp. West Indies, Indian Ocean, Australia. *T. (Eutrochus) jujubinus*, Linn. (lxxxix, 82).

TURCICA, H. and A. Adams. Shell conoidal, thin, subdiaphanous, imperforate, ornamented with revolving granulated ribs; subangulated at the periphery; suture channeled; columella tortuous, pointed in front, in the middle spreading into a lamina, with one or two teeth on its edge. *T. moniliferus*, Ads. (lxxxix, 51).

TROCHODON, Seeley, 1861. Resembling Zizyphinus, thin, having on the columella two prominent teeth, = Turcica (?). *T. cancellatus*. Cambridge Greensand.

PTYCHOSTYLUS, Gabb. According to the characteristics given by Gabb, apparently does not differ essentially from Turcica. The columella is solid, with two oblique folds. *P. coffea*, from California, is quoted as the type.

LISCHKEIA, Fischer. Uncharacterized. *T. moniliferus*, Lam. Japan.

ODONTOTROCHUS, Fischer. Uncharacterized. *T. chlorostomus*, Menke. Australia.

THALOTIA, Gray. Shell ovate-turriculated, rather thick, not umbilicated; whorls flattened, with revolving ribs, which are sometimes granulated; aperture subrotund; columella tuberculate, truncate in front; outer lip rather thick, crenulated within. 8 sp. Australia, Indian Ocean. *T. conicus*, Gray (lxxxix, 52).

ELENCHUS, Humphrey. Shell elevated conoidal, not umbilicated, spire sharp; whorls rather flat, smooth, polished, usually with distant revolving incised lines; aperture suboval; columella with a tooth-like projection in the middle; outer lip thickened within. 6 sp. Australia. Brilliantly colored shells,

like Phasianella, but very pearly inside. *T. lineatus*, Lam. (lxxxi, 53).

LESPERONIA, Tournouer. Shell pearly, imperforate, elongate-conical, whorls in the type carinated; aperture entire, oblique, pyriform; peristome continuous, margined; columellar margin anteriorly expanded. Operculum (?). *Distr.*—Fossil. Oligocene; Dax. *T. princeps*, Tourn. (lxxxi, 54).

CANTHARIDUS, Montfort. (Cantharis, Fer. Cantharidium, Montf.) Shell ovate, thin; outer lip acute; the columella wants the conspicuous tooth seen in Elenchus; the whorls are encircled by striæ and not polished; interior highly iridescent. 6 sp. Australia. *T. iris*, Chemn. (lxxxi, 55).

FLEMINGIA, de Koninck, 1881. (Trochella, M'Coy.) Shell thin, extended-conical, pointed; whorls numerous, striate or smooth, periphery usually angular; columella thin, slightly extended, forming a point below. Sil. to Carb. *F. Hisingerianus*, de Kon.

BANKIVIA, Beck. Shell subulate, with sharp spire, polished, bright-colored; whorls smooth, flattened, without epidermis; aperture subovate, rather large, not nacreous within; columella twisted, truncated in front; outer lip simple, sharp. Australasia. *T. varians*, Beck (lxxxi, 56).

TROCHOCOCHLEA, Klein. (Osilinus, Phil. Labio, Gray. Melagraphia, Stentz.) Shell elevated, turbiniform, whorls bluntly angled at the periphery, or with revolving carinæ; outer lip thin, smooth within; inner lip spreading, twisted, dentate below; no umbilicus. 10 sp. Europe, W. Africa, Australia. *T. multicarinatus* (lxxxi, 57).

GAZA, Watson. Shell trochiform, pearly; margin of aperture callously reflected; columella mucronately angulated in front; umbilicus with nacreous callus. Operculum corneous, multi-spiral. *Distr.*—*T. dædala*, Watson. Fiji Is. 610 fathoms. Related in general form to Trochocochelea, but strongly distinguished by its reflected lip.

CALLOGAZA, Dall. Resembling Gaza, but the umbilical callus is only partly reflected over the umbilicus, the pillar is straight, not mucronate, and the nacreous layer is overlaid by a thin, porcellaneous layer and a delicate epidermis. 2 sp. West Indies. *T. superba*, Dall.

MICROGAZA, Dall. Shell flattened, rotelliform, resembling a Gaza without reflected lip or umbilical callus, brilliantly nacreous when fresh, and having a distinctly scalariform umbilicus. West Indies. *T. rotella*, Dall.

MONODONTA, Lam. (Labio, Phil.) Shell oval or conoidal, not umbilicated; aperture rounded, angulated behind; columella arcuated, truncated at the base, and terminating in a tooth with channeled side; whorls with revolving riblets, which are usually

tuberculate; outer lip thickened and denticulated within. 6 sp. Indo-Pacific. *T. australis*, Lam. (lxxxix, 58).

CRASPEDOTUS, Phil. (Otavia, Gray. Olivia, Cantraine. Danilia, Brusina.) Shell subconoidal, not umbilicated; whorls convex, tuberculated in spiral series or cancellated; columella twisted, forming a false umbilicus and presenting a strong tooth entering the aperture; outer lip sillonated within, and having an external varix. 2 sp. Mediterranean, N. Caledonia.

EUCHELUS, Phil. (Aradasia, Gray.) Shell conoidal, turbinated, umbilicated; whorls rounded with granulated revolving ribs; columella lamellarly produced into a central tooth; outer lip thickened and crenulated within. Opercular whorls rather few, rapidly increasing. 11 sp. Indo-Pacific. *T. canaliculatus* (lxxxix, 59).

HUTTONIA, Kirk, 1882. Shell turbinated, subglobose; perforate or imperforate; columella with a deep notch at the anterior end; outer lip thickened and crenated internally. *Distr.*—3 sp. New Zealand. *T. bella*, Kirk. Distinguished from Euchelus by having a deep notch instead of a small tooth on the front of the columella.

PERRINIA, H. and A. Adams. Shell trochiform, with flattened, cancellated whorls; aperture subquadrangular; columella nearly straight, with a few posterior tubercles; outer lip subcrenulated within. *P. angulifera*, Adams.

CLANCULUS, Montfort. Shell conoidal or turbinated, not umbilicated; whorls mostly granulous; aperture contracted; columella spirally twisted, forming a false umbilicus, plicated throughout and terminating in a multidentate varix; outer lip dentated within, with sometimes a larger superior tooth. 32 sp. Indo-Pacific, Mediterranean. *T. puniceus*, Phil. (lxxxix, 60).

CAMITIA, Gray. Shell depressed, polished, not umbilicated; whorls rounded; aperture transverse; columella much twisted and produced anteriorly into a lamella, ending in a tooth; outer lip smooth within. *T. vitellinus*, Gould (lxxxix, 61).

LEUCORHYNCHIA, Crosse. Shell perforated, polished, few-whorled; aperture rounded, not pearly; basal margin callously produced across the base of the shell beyond the umbilicus, but without closing it. *T. Caledonica*, Crosse (lxxxix, 71).

OXYSTELE, Philippi. Shell depressed conoidal, smooth, not umbilicated; umbilical region covered by a shining callous expansion of the columella; columella flattened, curved anteriorly to join the outer lip. 5 sp. Australian seas. *T. merula*, Chemn. (lxxxix, 62).

ATAPHRUS, Gabb. Shell form of Oxystele, but the columellar lip anteriorly grooved, the groove terminating in a tubercle above. Cretaceous; North Carolina, California. *T. Kerri*, Gabb (lxxxix, 63).

TROCHISCUS, Sowb. (*Norrisia*, Bayle.) Shell thick, conoidal, orbicular, covered by an epidermis, smooth; widely umbilicated, umbilicus surrounded by the callous extension of the columella; outer lip not thickened or sculptured within. Operculum with the edges of the whorls elevated, scaly. *T. Norrisii*, Sowb. (lxxxix, 64). West Coast of North America.

DILOMA, Philippi. Shell conoidal, smooth, not umbilicated; whorls rather few, convex; aperture subrotund; columellar lip excavated in the middle and expanded over the umbilical region, produced laterally to join the outer lip; outer lip thin, unarmed. 12 sp. Pacific. *T. Æthiops*, Gmel.

PHOTINULA, H. and A. Adams. Shell orbicular, heliciform, sub-depressed, not umbilicated; spire acute; whorls with revolving lines, smooth, polished; umbilical region covered by callus; columellar lip thick, outer lip not thickened, smooth within. 2 sp. South Seas. *T. tæniata*, Wood (lxxxix, 65).

CHRYSTOSTOMA, Swainson. Shell very thick, globular-turbinated, polished; spire small, body-whorl large, rounded; margin of aperture thick, especially on the columella; umbilicus covered by a callosity. 1 sp. Indo-Pacific. *T. Nicobaricus* (lxxxix, 66).

LIOTROCHUS, Fischer. Not characterized. *T. callosus*, Koch.

MARGARITA, Leach.

Distr.—20 sp. Boreal, under stones and sea-weed near low-water. *M. helicina*, Fabr. (lxxxix, 67).

Shell thin, globular-conical, umbilicated; whorls rounded, smooth; aperture rounded, pearly; lip sharp, smooth.

BEMBIX, Watson. Shell elevated, conical, carinate, base inflated, umbilicated, thin, pearly, epidermis thin, membranaceous. *M. æola*, Watson. Japan.

MACHÆROPLAX, Friele. Shell more or less conoidal, distinctly umbilicated, unicolored, variously sculptured; aperture subangulated, peristome interrupted. Operculum corneous. *M. striata*, Leach (lxxxix, 68).

SOLARELLA, S. Wood. With large crenated umbilicus. Fossil, Crag of England; recent, one California species. *M. peramabilis*, Carp.

MARGARITELLA, Meek and Hayden. Shell subdiscoidal or nearly lenticular, thin; nacre of interior bright; umbilicus large, deep, and entirely without crenate margins; volutions narrow, very much depressed, the last one sharply angular around the periphery, and obtusely subangular around the umbilicus; aperture transversely rhombic; lip thin and simple; surface cancellately striated in the typical species. Cretaceous; United States. *M. flexistriata*, Evans and Shumard (lxxxix, 69, 70).

ENIDA, Adams, 1860. Whorls ornamented with spiral and squamous striæ, sutures canaliculated, last whorl carinated at

the periphery; inner lip somewhat expanded, and in the middle reflexed; umbilical margin crenulated. The group is founded upon three species from Japan; cretaceous and tertiary species occur. It is doubtfully distinct from *Solariella*. *M. Japonica*, A. Ad.

UMBONELLA, A. Ad. Shell globosely conoidal, solid, porcelaneous, polished, narrowly umbilicated; aperture subquadrate, the margin simple, a little dilated in front; umbilicus narrow, margin crenulately rugose. *M. murrea*, Reeve. Japan.

VITRINELLA, C. B. Ad.

Distr.—18 sp. W. Coast Centr. Am., West Indies. *V. anomala*, d'Orb. (lxxx, 72).

Shell minute, depressed turbiniform, widely umbilicated; aperture large, rounded.

VALVATELLA, Gray. Shell conic; whorls rounded, with laminar periostraca; axis imperforate; aperture circular, peristome simple. *V. Grænlantica*, Gray.

BATHYMOPHILA, Dall. When young umbilicated like *Margarita*, but the nearly adult has a broad, flattened, minutely granulated pillar, with a polished small tubercle at its end; the adult has this tubercle enlarged, forming a blunt tooth, with granulated surface. *M. euspira*, Dall. W. Indies.

? CLISOSPIRA, Billings, 1865.

Distr.—*C. curiosa*, Billings. Silur.; Canada.

Trochiform, surface reticulated; aperture widely expanded all round in a plane which is at a right-angle (or nearly so) to the longitudinal axis of the spire, the latter conical. The cavity occupied by the animal appears to be, at least in the lower part, not spirally coiled, as in the ordinary gastropods, but straight and central, with the lip spread out all round, trumpet-like. There is some evidence that towards the apex of the spire it is spirally coiled.

Position uncertain; may be more nearly allied to *Trochita*.

FAMILY STOMATELLIDÆ.

Shell paucispiral, auriform, the last whorl rapidly enlarging to the aperture, nacreous within. Operculum, when present, corneous, multispiral.

Animal too large to entirely enter the shell.

STOMATELLA, Lam.

Etym.—Diminutive of *stoma*, the aperture.

Distr.—33 sp. Cape, India, North Australia, China, Japan, Philippines. *S. imbricata*, Lam. (lxxx, 73). *S. Cumingii*, A. Ad. (lxxx, 74).

Shell ear-shaped, regular; spire small; aperture oblong, very large and oblique, nacreous; lip thin, even-edged. Operculum circular, horny, multispiral. On reefs and under stones at low-water.

STOMATIA, Helbing.

Etym.—*Stoma*, the aperture.

Distr.—12 sp. Java, Philippines, Torres Straits, Pacific. Under stones at low-water.—CUMING. Fossil: M. d'Orbigny refers to this genus 18 species, ranging from the L. Silurian to the chalk. North America, Europe.

Shell like *Haliotis*, but without perforations, their place being occupied by a simple furrow; surface rugose, spirally ridged; spire small, prominent; aperture large, oblong, outer margin irregular.

Animal spiral, too large entirely to enter the shell; frontal lobes digitated, foot large, tubercular, greatly produced behind, lateral membrane fringed, ending anteriorly on the left side in a fimbriated crest under the eye-pedicel, and on the right in a slightly projecting fold or gutter leading to the respiratory cavity. Operculum, none.

Stomatia, like *Harpa* and some nudibranchs, has the power of spontaneously throwing off the hind-part of the foot when the animal is irritated, and *Gena* exhibits the same peculiarity; specimens in spirits have the foot usually truncated from this cause. Most numerous at the Philippines, on coral reefs, but also found under stones at low-water.

MICROTINA, H. and A. Adams. (*Microtis*, A. Ad.) Shell suborbicular, depressed, spire but slightly developed; whorls with two small tuberculated ribs; columellar lip twisted; aperture transversely oval. No operculum. Animal as in *Stomatia*, but the foot with a deep anterior fissure for the head, and with the front edge bilobed. 2 sp. Philippines, New Caledonia. *S. tuberculata*, Ads. (lxxxix, 75).

NIPHONIA, Adams. Shell like *Stomatella*, but very thin; columellar lip internally thickened, and gradually passing into the outer lip. *S. pulchella*, A. Ad. Japan.

GENA, Gray. Shell subspiral, oblong, auriform, depressed, smooth or striated; spire flattened, nearly obsolete; aperture very large. No operculum. Animal with the front lobes plumose; foot very large, tubercular, posteriorly produced; lateral membrane not fringed, more or less extended, and partially covering the shell. 16 sp. Red Sea, Indian Ocean, Philippines, Australia. *S. striatula*, Ads. (lxxxix, 76).

PHANETA, H. Adams.

Distr.—*P. Everetti*, H. Adams (lxxxix, 77, 78). Siniwan River, Borneo; attached to submerged logs.

Shell imperforate, trochiform; few-whorled, the last carinated,

expanded, with depressed base; aperture large, rounded, sub-sinuuated behind, pearly within; columella revolute, acute; lip simple.

Apparently not an operculated shell. The whole appearance, especially the pearly interior, reminds one of the Trochidæ, and Mr. Adams is evidently mistaken in referring it as he does to the family Valvatidæ.

BRODERIPIA, Gray.

Etym.—Named in honor of W. J. Broderip, Esq., the distinguished conchologist.

Distr.—3 species. Philippines, Grimwood's Island, South Seas.—CUMING. *B. iridescens*, Brod. (lxxxix, 79, 80).

Shell minute, limpet-shaped, with a posterior submarginal, non-spiral apex; aperture oval, as large as the shell, brilliantly nacreous.

VELAINELLA, Vasseur.

Etym.—Named after Charles Velain, a French naturalist.

Distr.—*V. columnaris*, Vasseur (lxxiii, 5). Eocene; Nantes, France.

Shell spiral, dextral, extremely elongated, thick and solid, nacreous within; aperture oval-oblique, peritreme continuous, left margin with a slight columellar swelling.

The nacreous interior brings this into the Trochidæ, but it is very distinct from any of the preceding forms.

FAMILY PLEUROTOMARIIDÆ.

Shell more or less conically elevated, turreted or trochiform, with a marginal slit in the upper part of the outer lip, or a row of perforations in the upper part of the whorl; aperture pearly within.

PLEUROTOMARIA, Defrance.

Etym.—*Pleura*, side; and *tome*, a notch.

Distr.—4 sp. West Indies, Moluccas, Japan. *Pl. Quoyana*, Fischer and Bernardi (lxxxii, 84). Fossil, 400 sp. Cambrian to Cretaceous; North America, Europe, Australia.

Specimens from clay strata retain their nacreous inner layers; those from the chalk and limestones have lost them, or they are replaced by crystalline spar. Pleurotomariæ with wavy bands of color have been obtained in the carb. limestone of Lancashire. In this extensive group there are some species which rival the living turbines in magnitude and solidity, whilst others are as frail as *Ianthina*.

Shell trochiform, solid, few-whorled, with the surface variously ornamented; aperture subquadrate, with a deep slit in its outer

margin. The part of the slit which has been progressively filled up forms a band round the whorls.

PTYCHOMPHALUS, Agass. (Cryptænia, Desl.) Heliciform or trochiform shells, with an almost smooth surface, a thick callosity covering the umbilical region and a distinct band on the posterior portion of the whorls, terminating at the aperture with a short slit, sometimes a simple fold. The smooth surface and umbilical callosity distinguish it from other Pleurotomariæ. Species numerous. Liassic to Cretaceous. *P. striatus*, Sowb. (lxxxii, 86).

LEPTOMARIA, Desl., 1865. Shell subturbinate, rather thin, generally ornamented with very numerous, subequal spiral striæ, band very narrow, placed near the middle of the whorls, slit in the outer lip very deep, axis solid or hollowed out. Mostly cretaceous to tertiary. *P. amæna*, Desl.

MURCHISONIA, d'Archiac.

Etym.—Named in honor of Sir Roderick I. Murchison.

Distr.—Fossil, 50 sp. L. Silurian to Permian; North America, Europe. *M. intermedia*, Verneuil (lxxxii, 86).

Shell elongated, many-whorled; whorls variously sculptured, and zoned like Pleurotomaria; aperture slightly channeled in front; outer lip deeply notched.

The Murchisoniæ are characteristic fossils of the palæozoic rocks; they have been compared to elongated Pleurotomariæ, or to Cerithia with notched apertures; the first suggestion is most probably correct.

MURCHISONIELLA, Mörch. A single living species is referred to this uncharacterized group. West Indies.

DISOTEKA, Gardner, 1880. Differs from Murchisonia in having two slit-bands. Cret.; England.

PORCELLIA, Lèveillé.

Distr.—10 sp. U. Silurian to Trias. Europe. *P. Puzo*, Lev. (lxxxii, 87).

Shell symmetrical, discoidal or planorbiform; periphery with a deep, marginal slit.

POLYTREMARIA, d'Orb.

Syn.—Trochotremaria, Ryckh.

Distr.—Carboniferous; Belgium. *P. catenata*, Kon. (lxxxii, 88).

Shell turbinated, heliciform, periphery pierced by a line of non-tubular perforations.

CATANTOSTOMA, Sandberger.

Distr.—Devonian, Trias. *C. clathratum*, Sandb. (lxxxii, 89).

Shell turbinated, heliciform or bulimiform; last whorl deflected; the peristome incomplete, irregular, slightly varicose on the last

whorl. At the place where this is deflected there is an elongated, kidney-shaped perforation surrounded by somewhat thickened margins; another small perforation is found about the centre of the basis, but in the outer lip it is likewise surrounded with a raised margin.

? BRILONELLA, Kayser.

Distr.—*B. serpens*, Kayser. Devonian; Germany.

Last whorl unwound and deflected upwards, so that the mouth lays upon the top of the spire; otherwise like *Pleurotomaria*.

ODONTOMARIA, Roemer.

Distr.—*O. elephantina*, Roemer. Devonian; Eifel.

Shell not spiral, extended-tubular, somewhat curved; mouth with slit terminating an external band.

TROCHOTOMA, Lycett.

Etym.—*Trochus*, and *tome*, a notch.

Syn.—*Ditremaria*, d'Orb. *Rimulus*, d'Orb.

Distr.—Fossil, 10 sp. Lias to Coral Rag; Britain, France, etc. *T. Humbertina*, d'Orb. (lxxxii, 90).

Shell trochiform, slightly concave beneath; whorls flat, spirally striated, rounded at the outer angles; lip with a single perforation near the margin.

TEMNOTROPIS, Laube.

Distr.—*T. carinatus*, Goldfuss. Trias; St. Cassian.

Shell ear-shaped, with rapidly enlarging keeled whorls, and a very large oval aperture; outer lip sharp with a deep slit, terminating a slit-band on the keel.

DITREMARIA, Deslonge.

Distr.—2 sp. Great Oolite and Coral Rag; France and Germany. *D. quinquecincta*, Ziet. (lxxxii, 91).

Shell trochiform; in place of the slit of *Trochotoma*, there are two elongated oval holes united by a transverse fissure; the base of the shell presents a large callosity, the umbilicus is deeply excavated, and a round tubercle arises from it; the aperture is contracted, and the upper angle of each lip bears a more or less distinct tooth.

SCHISMOPE, Jeffreys, 1856.

Etym.—*Schisme*, a slit, and *ope*, a hole.

Syn.—*Woodwardia*, Fischer, 1861.

Distr.—4 sp. Mediterranean, Japan. Fossil, 1 sp. Miocene; Bordeaux.

Shell like *Scissurella*, but the spire is laterally compressed, as in *Stomatia*, and is not so trochiform. The slit in the peristome

of the young shell is converted into a foramen in the adult; it does not commence until the animal is half-grown.

S. striatula, Ph., is a littoral species, whilst all the species of *Scissurella* inhabit deep water.

Scissurella and *Schismope* are the analogues respectively to *Pleurotomaria* and *Trochotoma*, differing only in size; but in the two former genera the shell is translucent, not nacreous, as in the two latter.

SCISSURELLA, d'Orbigny.

Etym.—Diminutive of *scissus*, slit.

Syn.—*Anatomus*, Montfort.

Distr.—Europe, 5 living, 4 tertiary species. *S. Bertheloti*, Webb (lxxxii, 92).

Shell minute, thin, not pearly; body-whorl large; spire small; surface striated; aperture rounded, with a slit in the margin of the outer lip; operculate. The young have no slit.

Animal like *Margarita*; tentacles long, pectinated, with the eyes at their base; foot with two pointed lappets and two long, slender pectinated cirri on each side. Operculum ovate, very thin, with an obscure subspiral nucleus.

No part of the animal is external to the shell. A living example occurred at Hammerfest, in 40–80 fathoms of water; when placed in a glass of sea-water it crawled up the side and scraped the glass with its tongue. It was pale and translucent when living, but turned inky black after immersion in alcohol.

SCHIZOTROCHUS, Monterosato. Operculum very thin; shell trochoidal. *S. crispata* (lxxxii, 93).

SEGUENZIA, Jeffreys.

Distr.—4 sp. Azores, W. Indies, Pernambuco. 718–1000 fms. *S. formosa*, Jeffreys (lxxxii, 94).

Shell globular or conical, glossy, without epidermis, exquisitely sculptured; upper part of the last whorl deeply and widely grooved; pillar abruptly notched below, and exhibiting a small tooth-like process; base either deeply umbilicated or imperforate.

Differs from the other genera by having a broad sutural slit, instead of on the periphery. Operculum very thin, paucispiral.

BASILISSA, Watson.

Distr.—7 sp. Pacific, W. Indies, Canaries, off La Plata, etc., at considerable depths. *B. lampra*, Watson.

Shell conical, carinate, umbilicate, pearly, last whorl sinuate above; columella straight, thin, excavated above, angulate but scarcely dentate below; aperture rhomboidal, the margin not continuous nor joined by palatal callus.

The sinus is wide, open, shallow, not deep-cleft as in *Seguenzia*,

and it lacks the sharp tooth on the pillar with strongly marked sinus above and below it, of that genus.

Specimens were obtained by the Challenger expedition at depths varying from 390 to 1900 fathoms.

FAMILY BELLEROPHONTIDÆ.

Shell globular, nautiliform, symmetrically convoluted; periphery carinated or sulcated, ending in a slit of the middle portion of the outer lip.

A large group of palæozoic fossils, the natural relations of which are very doubtful. They have been placed with the Cephalopoda, Bullidæ, Pteropoda, etc., but the slit shell appears to indicate closer affinities with the Pleurotomariidæ, and the best modern systematists place them in the vicinity of that family.

BELLEROPHON, Montfort, 1808.

Syn.—*Microceras*, Hall.

Distr.—150 sp. Cambrian to Carb.; North America, Europe, Australia, India. *B. striatus*, d'Arch. (lxxxii, 95).

Shell symmetrically convoluted, globular, or discoidal, strong, few-whorled; whorls often sculptured; dorsally keeled; aperture sinuated and deeply notched on the dorsal side.

Microceras, Hall, appears to be founded on the embryonic volutions of a *Bellerophon*.

WARTHIA, Waagen, 1880. Smooth, globular, not umbilicated, without slit-band, and having a tolerably deep rounded sinuosity on the outer lip; inner lip only very slightly callous. Fossil. Salt Range, India. *B. brevisinuata*, Waagen (lxxxii, 96, 97).

MOGULIA, Waagen, 1880. Globular, without well-developed slit-band; mouth oval, outer lip with a shallow angular emargination, inner lip callous; no spiral sculpture. *B. regularis*, Waagen (lxxxii, 98, 99). Carboniferous; India. Possibly = Warthia.

PATELLOSTIUM, Waagen, 1880. Mouth very much expanded and the lips spread out patella-like, the inner lip not being cut out where it touches the preceding volution. *Bell. macrostoma*, Proem. *Bell. megalostoma*, Eichw.

WAAGENIA, L. G. de Koninck, 1882. Shell subglobular, usually a little higher than wide, and slightly compressed on the sides; whorls completely embracing, leaving no trace of umbilical opening, that region being covered with a callus which appears to have been deposited by a special organ, of which the related genera are deprived; slit-band narrow, a little inflated; surface covered with small imbricated plications or fine lines of growth, and showing a pattern of coloring. Distinguished from *Bellerophon* by the umbilical callus. *Distr.*—3 sp. Carboniferous; Europe. *W. Ferussaci*, d'Orb.

BUCANIA, Hall, 1847.

Syn.—Phragmostoma, Hall, 1862. Centrotheca, Salter.

Shell planorbiform, the whorls exposed equally above and below, with revolving striæ; last whorl much enlarged at the aperture. Silur., Carb. *B. expansa*, Hall (lxxxii, 100, 1).

BUCANELLA, Meek. Shell without slit-band.

TROPIDODISCUS, Meek. Strongly compressed, disciform, widely umbilicated, with a high keel and very short incision in the outer lip; callosity on the inner lip very little developed. Silur., Carb. *B. curvilineata*, Conr. (lxxxii, 2, 3).

TREMANOTUS, Hall, 1864. (Salpingostoma, Roemer, 1876.) Like Bucania, but in place of the slit-band, a row of oval openings on the last whorl. Mouth strongly expanded. Silurian. *T. alpheus*, Hall.

TUBINA, Barrande, 1868. Like Tremanotus, but with three rows of openings instead of one, on which long hollow tubes are placed. Mouth very little expanded. Silurian; Bohemia.

EUPHEMUS, M'Coy, 1844. Umbilicus absent or small, shell with spiral folds, not continued on the last whorl, aperture slightly contracted, lip sometimes emarginate, no distinct slit-band. Carb.; Gt. Brit., Salt Range, India. *B. (Euphemus) Indicus*, Waagen (lxxxii, 4).

TROPIDOCYCLUS, Koninck, 1882. *T. curvilineatus*, Conr.

STACHELLA, Waagen, 1880. More or less globular, smooth, unsymmetrical, mostly umbilicated on one side and with a closed umbilicus on the other; slit-band distinct, but superficial, slit shallow. Fossil. Salt Range, India. *B. bifrons*, Waagen (lxxxii, 5, 6).

PHRAGMOSTOMA, Hall, 1861. Mouth much expanded, with the slit forming a sinus; slit-band well marked; inner lip expanded into a septum. Devon.; New York. Is very closely related to Carinaropsis, Hall.

BELLEROPHINA, d'Orb.

Distr.—Cretaceous; Europe. *B. Vibrayi*, d'Orb. (lxxxii, 7).

Shell subsymmetrical, globular, the whorls embracing as in Bellerophon, but without sinus; sides slightly unequal, the spire-whorls perceptible above, while below the umbilicus is very narrow.

CARINAROPSIS, Hall.

Distr.—Fossil, 2 sp. Silurian; America. *C. carinata*, Hall.

Shell having a patelloid aspect. Spire usually attenuated; body-whorl expanded abruptly; cavity shallow, presenting a kind of septum as in Crepidula.

CYRTOLITES, Conrad.

Etym.—*Kurtos*, curved, *lithos*, stone.

Distr.—Fossil, 13 sp. L. Silur.—, Carb.; N. Am., Eur. *C. ornatus*, Conrad.

Shell thin, symmetrical, horn-shaped or discoidal, with whorls more or less separate, keeled and sculptured.

CYRTONELLA, Hall, 1879. Shell ovoid, trumpet-shaped; volutions one or more in the same plane; apex minute, making about a single turn, and rapidly expanding beyond, peristome entire; dorsum angular or subcarinate; surface sculptured. *C. mitella*, Hall. Devon.; N. Y.

FAMILY MACLUREIDÆ.

MACLUREA, Lesueur.

Etym.—Named after William Maclure, the first American geologist.

Distr.—Fossil, 12 sp. Palæozoic; North America, Scotland (Ayrshire, M'Coy). *M. Logani*, Salter lxxxii, 8, 9). *M. magna*, Lesueur (lxv, 10).

Shell discoidal, few-whorled, longitudinally grooved at the back, and slightly rugose with lines of growth; dextral side convex, deeply and narrowly perforated; left side flat, exposing the inner whorls. Operculum sinistrally subspiral, solid, with two internal projections, one of them beneath the nucleus, very thick and rugose.

This singular shell abounds in the "Chazy" limestone of the United States and Canada; sections of it may be seen even in the pavement of New York. "We are indebted to Sir W. E. Logan, of the Geological Survey, Canada, for the opportunity of examining a large series of silicified specimens, and of figuring a perfect shell, with its operculum *in situ*. It has more the aspect of a bivalve, such as *Requienia Lonsdali*, than of a spiral univalve, but has no hinge. Many of the specimens are overgrown with a zoophyte, generally on the convex side only, rarely on both sides.

"The Maclurea has been described as sinistral; but its operculum is that of a dextral shell; so that the spire must be regarded as deeply sunk and the umbilicus expanded, as in certain species of Planorbis; unless it is a case conversely parallel to Atlanta, in which both shell and operculum have dextral nuclei. The affinities of Maclurea can only be determined by careful examination and comparison with allied, but less abnormal forms, associated with it in the oldest fossiliferous rocks; its relation to Euomphalus (p. 218) is not supported by the evidence of Sir W. Logan's specimens."—WOODWARD.

FAMILY HALIOTIDÆ.

Shell spiral, ear-shaped, with a greatly expanded, flattened body-whorl, and large basal aperture; dorsally perforated in a

single spiral series; interior pearly, with a large central muscular scar. No operculum.

Animal with a short muzzle and subulate tentacles; eyes on pedicels at the outer bases of the tentacles; branchial plumes 2; mantle-margin with a posterior (anal) fold or siphon, occupying the slit or perforation in the shell. Operculum lobe rudimentary; lingual dentition similar to *Trochus*.

The species are remarkable for the beauty and variety of their shells and are mostly tropical in distribution. One small species is eaten by the inhabitants of the Channel Islands (Gt. Britain), and others are important articles of diet in China, Japan, and among the Chinese settled in California. The shells are largely used for the manufacture of mother-of-pearl ornaments and for inlaying in papier-maché work.

HALIOTIS, Linn.

Ear-shell. *Etym.*—*Halios*, marine, and *ous* (*otos*), an ear.

Distr.—75 sp. Britain, Canaries, Cape, India, China, Australia, New Zealand, Pacific, California. Fossil, 4 sp. Cretaceous. *H. Midæ*, Linn. (lxxxiii, 10). *H. gigantea*, Chemn. (lxxxiii, 11).

Shell ear-shaped, with a small flat spire; aperture very wide, iridescent; exterior striated, dull; outer angle perforated by a series of holes, those of the spire progressively closed.

Animal with fimbriated head-lobes; side-lobes fimbriated and cirrated; foot very large, rounded. Lingual teeth, median small; laterals single, beam-like; uncini about seventy, with denticulated hooks, the first four very large.

DERIDOBANCHUS, Ehrenberg. Shell large and thick, like *Haliotis*, but entirely covered by the thick, hard, plaited mantle of the animal. *D. argus*, Red Sea.

TEINOTIS, H. and A. Adams. Shell depressed, elongated, ear-shaped; spire small, and placed posteriorly; hinder part of the foot in the animal stretches far over the shell. 2 sp. East Indies. *H. asinina*, Linn. (lxxxiii, 12).

PADOLLUS, Montfort. A strong, rounded, spiral rib within the line of perforations, and forming a spiral sulcus inside the shell. Form rounded-oval, with rather large, sublateral spire. *H. tri-costalis*, Linn. (lxxxiii, 13).

SULCULUS, H. and A. Adams. Very like *Padollus*, having the same dorsal rib, but the form of the shell is more elongated, and the spire smaller and subterminal. *H. Janus*, Reeve (lxxxiii, 14).

SUBORDER EDRIOPTHALMA.

Shell conical, not spiral, porcellaneous. No operculum. Eyes sessile.

FAMILY FISSURELLIDÆ.

Shell conical, limpet-shaped; apex recurved; nucleus spiral, often disappearing in the course of growth; anterior margin notched or apex perforated; muscular impression horseshoe-shaped, open in front.

Tongue with a central median tooth, five denticulated uncini, and numerous slender, hooked laterals. Body broad and conical. Head with a short, wide muzzle; tentacles subulate, with the eyes on slightly elevated tubercles at their external bases. Mantle-margin fissured in front, the free edges forming an anal siphon occupying the anterior fissure, or perforation in the apex of the shell; gills two, symmetrical, on the back of the neck. Foot dilated, sides with the upper part furnished with a series of short cirri or rudimentary filaments. Operculum none. Phytophagous and littoral. The nucleus of the shell is always spiral, although in the adult the shell assumes a conic form; in some genera there is a rudimentary spire in the young state, which disappears in the course of growth.

FISSURELLA, Lam.

Ety.—Diminutive of *fissura*, a slit.

Distr.—125 sp. Universal, but mostly in warm seas. Fossil, 30 sp. Carboniferous—. *F. picta*, Gmel. (lxxxiii, 15).

Shell oval, conical, depressed, with the apex in front of the centre, and perforated; surface radiated or cancellated; muscular impression with the points incurved.

In very young shells the apex is entire and subspiral; but as the perforation increases in size, it encroaches on the summit, and gradually removes it. The key-hole limpets are locomotive; returning, however, to their accustomed station, the rocky surface of which is worn into an impression corresponding with the outline of the shell.

CREMIDES, H. and A. Adams. Surface rugose, muricated or cancellated; the lip denticulated. *F. nodosa*, Born (lxxxiii, 16).

FISSURIDEA, Swainson. Shell subconic, capuliform, the posterior summit narrowly perforated. *F. pileopsoides*, Reeve (lxxxiv, 30).

LUCAPINA, Gray. Shell oval-oblong, conic, depressed, cancellated; summit subcentral, the oval opening surrounded by a callus; margin crenulated. *F. crenulata*, Sowb. (lxxxiii, 17).

Mantle-margin fimbriated, reflexed more or less over the edges of the shell. This group includes all those reticulated and cancellated forms generally referred to *Fissurella*, which have the margin of the aperture crenulated, and in which the perforation, internally, is transversely truncate and sometimes slightly concamerated.

GLYPHIS, Carpenter. (*Capiluna*, Gray.) Animal with the edge of the mantle fimbriated, and covering the margin of the shell. Shell with the surface cancellated, the margin crenulated, callosity often truncate, sometimes laminated. Young shell Rimuliform, with the spire absorbed in the increasing aperture. *F. inæqualis*, Sowb.

CLYPIDELLA, Swainson. Shell oval, rugose, slightly elevated, truncated at the anterior extremity; perforation large, subcentral or somewhat anterior. Mantle-margin double, the edges scalloped and fringed, covering the sides of the shell; anal siphon surrounded by a fimbriated membrane; foot large, fleshy and tubercular, with a series of rudimentary, tentacular filaments on the sides near the fore-part. *F. pustulata*, Lam. (lxxxiv, 31).

FISSURELLIDÆA, d'Orb. Shell small relative to the size of the animal, depressed; perforation large, oval, central, with a callous border on the inner face; margin smooth. Mantle greatly developed, thickened at the edges and nearly covering the shell; foot very large and elongated. *F. hiantula*, Lam. (lxxxiii, 18).

MACROSCHISMA, Swainson. Shell square-oval, roughly rayed, truncate at the end; perforation very large, subtriangular, elongated. Animal large, larviform, greatly elongated, with the shell situated towards the posterior end. *F. maxima*, Ads. (lxxxiii, 19).

PUPILLA, Gray. Shell depressed, nearly smooth; perforation large, subcentral, oblong; margin white. Mantle coriaceous, entirely covering the shell, orifice of anal siphon small, oblong, at the anterior third; foot granulated, shorter than the mantle. The shell may be readily known by the sharp-edged, white border, which is received into the integument of the animal like one of the valves of a Chiton. It is an inhabitant of South Africa. *F. apertura*, Born (lxxxiii, 20).

RIMULA, Defrance.

Ety.—Diminutive of *rima*, a fissure. *Syn.*—Rimularia.

Distr.—Several species found on sandy mud at low-water, or dredged in from 10 to 25 fathoms. Philippines.—CUMING. Fossil, 3 species. Bath Oolite to Coral Rag; Britain and France. *R. exquisita*, Ads. (lxxxiv, 32).

Shell thin and cancellated, with a perforation near the anterior margin.

PUNCTURELLA, Lowe. (*Cemoria*, Leach. *Diadora*, Gray.) Shell conical, elevated, with the apex recurved; perforation in front of the apex, with a raised border (septum) internally; surface cancellated. Mantle-margin simple, anal siphon prominent, tubular, with six papillæ in front and four behind; foot with a rudimentary operculigerous lobe. *Distr.*—6 sp. Greenland, Boreal America, Norway, North Britain, Terra del Fuego.

In 20 to 100 fathoms water. Fossil, in the glacial formations of North Britain. *R. Noachina*, Linn. (lxxxiv, 33).

CRANOPSIS, Adams. Fissure about the middle of the anterior side; an internal vaulted chamber over the foramen, resembling that of *Puncturella*, *Cr. pelex*, Adams (lxxxiv, 34, 35), from the China seas, is the type, and one or two additional species have been since described.

SEMPERIA, Crosse. (Named after M. O. Semper, of Altona.) Shell conical, apex posteriorly recurved, anteriorly fissured; the fissure is marginal in the young shell, but in the adult the margins grow around it so that it becomes subdorsal, or separated from the margin externally, though connected with it internally by a channel. Embraces at different growth-stages characters of *Rimula*, *Emarginula*, *Clypidina*. 2 sp. Madeira. Fossil; Paris basin. *S. elegans*, Crosse (lxxxiv, 36).

EMARGINULA, Lam.

Etym.—Diminutive of *emarginata*, notched.

Syn.—Nesta, H. Adams.

Distr.—40 sp. West Indies, Britain, Norway, Philippines, Australia. Range from low-water to 90 fathoms. Fossil, 40 sp. Carboniferous.—*E. fissura* (lxxxiv, 37).

Shell oval, conical, elevated, with the apex recurved; surface cancellated; anterior margin notched. Muscular impression with recurved points. The nucleus (or shell of the fry) is spiral, and resembles *Scissurella*. The anterior slit is very variable in extent. The animal of *Emarginula* (and also of *Puncturella*) has an isolated cirrus on the back of the foot, perhaps representing the operculigerous lobe.—FORBES. Lingual dentition (xii, 50), median teeth subquadrate; laterals four, oblong, imbricated; uncini about 60, the first large and thick, with a lobed hook, the rest linear, with serrulated hooks.—LOVÉN.

SUBEMARGINULA, Blainv. (*Hemitoma*, Swain. *Siphonella*, Issel. *Montfortia*, Recluz.) Anterior margin with a slight channel and a canal-like prolongation of it proceeding towards the apex, on the inside face of the shell. *E. octoradiata*, Sowb. (lxxxiv, 37).

ZEIDORA, Adams. Shell like *Emarginula*, with the margin of the aperture crenulated and anteriorly deeply fissured, but there is posteriorly an internal, flat, semilunar septum present, which distinguishes this subgenus from any other Fissurellidæ. *E. reticulata*, A. Ad. (lxxxiv, 39, 40).

DESLONGCHAMPSIA, McCoy, 1850. (Dedicated to Dr. Eudes Deslongchamps, the renowned French palæontologist.) Shell patelliform, apex acute, excentric; with a wide longitudinal anterior sulcus, produced into a rounded lobe. Fossil, 3 sp. Lower Oolite; England, Normandy, Galicia. *D. Eugeni*, McCoy (lxxxiv, 41).

PARMOPHORUS, Blainv.

Etym.—*Parme*, a shield, and *phoreus*, a bearer. Duck's-bill limpet. *Syn.*—*Scutus*, Montf.

Distr.—12 sp. East Indies, Philippines, Australia. Fossil, 3 sp. Eocene; Paris basin. *P. australis*, Bl. (lxxxiii, 21).

Shell lengthened-oblong, depressed; apex posterior; front margin incurved. Muscular impression horseshoe-shaped, elongated. The shell is smooth and white, and permanently covered by the reflected borders of the mantle. The animal is black, and very large compared with the shell; its sides are fringed with short cirri, and its eyes sessile on the outer bases of thick tentacles. Occurs in shallow water, walking freely.

TUGALIA, Gray. Shell cancellated, with crenulated margin. *P. elegans*, Gray.

COCCULINA, Dall.

Distr.—2 sp. New England, deep waters. *C. Rathbuni*, Dall.

Shell patelliform, apex posteriorly inclined, with a deciduous spiral nucleus; margin entire.

Animal blind, with prominent head and muzzle; two tentacles; gill single, plumose, asymmetrical, extending between the under surface of the mantle and the foot (from a point above and behind the head) backward on the right side; anal opening above and behind the head; mantle-margin plain; margin of the foot without processes, excepting a single filament on each side. Radula with a small or moderate rachidian tooth, three inconspicuous and a fourth larger, dentate laterals, uncini numerous. The male has a verge permanently exerted from the inner side of the right tentacle.

The shell resembles that of the Patellidæ, but the animal is more nearly allied to the Fissurellidæ. Mr. Dall has formed a family for the two species known.

ADDISONIA, Dall.

Etym.—In honor of Prof. Addison E. Verrill, of Yale College.

Distr.—2 sp. New England, Mediterranean Sea. *A. paradoxa*, Dall.

Shell ovate, subconical, strongly asymmetrical with curved apex; no epidermis; margin plain.

Animal with two tentacles; no eyes; foot and mantle without tubercles or processes; gill composed of leaflets as in *Patella*, the series starting on the right behind the head and continued within the mantle-edge backward, the body of the animal being asymmetrically placed with regard to the aperture of the shell to afford room for the enormous series of branchial leaflets; anus opening behind and above the head slightly to the right of the median line, and indicated by a small papilla. Radula with

a large, simple rachidian tooth with, on each side, two large, simple, transverse laterals, followed by two minute ones, and a large outer lateral with a strong tridentate cusp, outside of which is a single scale-like flat uncinus, bearing an elongated, thickened ridge, but no cusp.

For this genus Mr. Dall has proposed a new family; he states that it might be incorporated with Cocculinidæ, "were it not for the differences in the branchiæ and in its dentition."

FAMILY PATELLIDÆ.

Shell wholly external, dish-shaped, with apex anteriorly directed; animal with two short tentacles, a non-extensible muzzle; branchiæ external or none; renal and anal aperture situated above the neck, between body and mantle-edge; no copulatory or external genital organs; mouth provided with horny jaw, and long radula with numerous peculiar black, opaque teeth, and pellucid or colored plates or bosses; metamorphosis of the embryo taking place in the egg, which is fertilized in the ovary.

The Limpets have been very thoroughly studied by Mr. Wm. H. Dall,* who has proposed an elaborate classification of them, including ordinal and subordinal as well as family and generic characters. I have mainly followed Mr. Dall's system in the diagnoses and sequence of the groups, but without giving them the same systematic values:—for example, I have used above his characters of the Order Docoglossa for the family Patellidæ, thus making the family more comprehensive than in his sense, and corresponding more nearly in conchological importance with the other families in this work. Similarly Mr. Dall's suborders correspond nearly with my subfamilies and his family characters are here treated as generic. The order Docoglossa is, as its name implies, founded upon peculiarities in the arrangement of the lingual dentition (xii, 51), but already two forms of limpets have been discovered which by their dentition cannot be placed in this order. Cuvier united the Patellidæ and Chitonidæ in his order Cyclobranchiata, characterized by the arrangement of the gills in a circle surrounding the body, but more recent investigators have ascertained a considerable diversity of gill-arrangement among the limpets, so that this term will no longer apply to them as a whole, although many of them agree with the Chitons in this feature.

SUBFAMILY LEPETINÆ.

Animal without branchiæ. Embryonic shell spiral.

* See his papers in *Am. Jour. Conch.*, v, vi, and *Proceedings of the National Museum*.

LEPETA, Gray.

Syn.—Cryptobranchia, Midd. pars. Propilidium, Gray, not Forbes and Hanley. Pilidium, Stimpson, not F. and H. nor Midd.

Shell conical, patelliform, with a subspiral nucleus, which is generally lost in early life, the permanent apex being erect or anteriorly directed.

Animal without eyes, without lateral teeth, with a rachidian tooth, and erect uncini; muzzle with an entire margin, which is extended backward into a tentacle-like filament on each side.

LEPETA (restricted), Dall. Apex erect. Rachidian tooth tricuspid, the middle cusp much larger; lateral teeth simply cuspidate. *L. cæca*, Müll. (lxxxiv, 42).

CRYPTOBRANCHIA (restricted), Dall. Apex inclined anteriorly. Rachidian tooth with three nearly equal denticles; uncini broadly hooked. *L. concentrica*, Midd. (lxxxiv, 43).

LEPETELLA, Verrill. Shell as in Lepeta. Animal differing in having eyes and in being provided with true lateral teeth and also with scale-shaped uncini. *L. tubicola*, Verrill. 200 to 400 fms., off New England coast.

PILIDIUM, Forbes. (Iotha, Gray. Ergina, Jeffreys.) Shell patelliform, apex anterior, generally deep-colored. Mantle fringed with cilia; rachidian tooth long, rhomboidal, bearing a very large black cusp with a simple denticle on each side, laterals with broad cusps striated beneath and obliquely bent, shafts slender. *P. fulvum*, Forbes. Northern America and European coasts.

SUBFAMILY ACMÆINÆ.

Embryonic shell conical. Animal usually having eyes and a plumose, cervical, external gill, with or without a marginal cordon; rachidian tooth rarely present, lateral teeth three in number.

ACMÆA, Esch.

Syn.—Tectura, Aud. Patelloida, Quoy and Gaim. Lottia, Gray. Iotha, Forbes. Patelloidea, Couth. Tectura, Gray. Scutellina, Gray. Scutella, Brod.

Distr.—25 sp. Mostly W. Coast of N. America, Europe, etc. *A. mitra*, Esch. (lxxxiv, 44).

Shell solid, patelliform; apex erect or anteriorly inclined. Animal. Muzzle frilled, produced at the lower anterior corners into two lappets or tubercles; no marginal cordon, the cervical gill alone present.

COLLISELLA, Dall. Muzzle-frill simple, entire, not produced into lappets or tubercles. *A. spectrum*, Reeve (lxxxiv, 45, 46). *A. variabilis*, Sowb. (lxxxiv, 47).

SCUTELLINA, Gray. Shell with a broad margin internally. 7 sp. Red Sea, Philippines, Pacific, Panama. *A. crenulata*, Brod.

PECTINODONTA, Dall.

Distr.—*P. arcuata*, Dall. West Indies.

Shell resembling *Acmæa*, with a blunt subcentral apex.

Animal blind, with the front part of the head between the tentacles and above the muzzle much produced upward and forward, extending considerably further forward than the end of the muzzle. Muzzle marginated, with lappets at the outer corners. Jaw thin, translucent. Gill exactly as in *Acmæa*; sides of foot and mantle-edge simple, nearly smooth.

LOTTIA, Gray.

Syn.—*Tecturella* and *Tecturina*, Carp.

Distr.—*L. gigantea*, Sowb. (lxxxiii, 22). West Coast of N. America.

Shell patelliform, depressed, the apex anterior.

Animal with a single cervical branchia, but also furnished with a branchial cordon of laminae between the mantle-edge and the foot, extending as far forward as the adductor muscle on each side and continuous behind; frill of the muzzle without lappets. The typical and only species is among the largest and most active of limpets, the shell attaining three inches in length.

SCURRIA, Gray.

Distr.—Several sp. West Coast of North and South America. *S. scurra*, Lesson (lxxxiv, 48).

Shell patelliform, conical, elevated, rather thick and of rude growth. Branchiæ completely surrounding the body, as in *Patella*, but having also the cervical plume of *Acmæa*; muzzle without lappets.

SCURRIOPSIS, Gemmellaro. Shell with radiating riblets crossed by concentric growth-lines. Jurassic.

SUBFAMILY PATELLINÆ.

Shell conical, with the apex turned forward; muscular impression horseshoe-shaped, open in front, as in the preceding groups.

Animal. Gills forming a row of leaflets surrounding the body; no cervical plume-like gill; radula provided with three lateral teeth on each side, and three uncini; rachidian tooth rarely present (xii, 51).

The continuous series of branchial lamellæ forming a fixed cordon between the mantle and foot, together with peculiarities of their lingual dentition, serve to distinguish this subfamily from the preceding one. These animals are strictly littoral in habit, living upon the rocks between tide-marks; they are chiefly sedentary, adhering firmly by atmospheric pressure, and

feeding on the sea-weed within reach of their long tongues; during the night-time, however, they make short excursions, indicated by the irregular tracks they form in their movements. They possess the power of excavating the surface of the rocks; but whether by mechanical attrition, aided by the hard crystalline spicula with which the foot is strengthened, or by the carbonic acid disengaged in respiration, has not been positively determined; perhaps both agencies are employed, the latter being more effective with limestone rocks, the former when, as sometimes occurs, the roosting place is excavated in timber.

PATELLA, Linn.

Etym.—Patella, a dish.

Syn.—Scutellastra, Cymbula, Olana, H. and A. Adams. Eruca, Tournefort. Patellites, Walch. Patellaria, Lihwyd. Cellana, H. Adams.

Distr.—150 sp. World-wide. Fossil, 100 sp. Silurian—*P. cærulea* (lxxxiv, 49).

Shell conical, more or less depressed, oval at the base; apex subcentral or anterior, from which usually radiate ribs, which are frequently nodose; mostly crenulated on the inner margin.

Animal. Foot smooth, branchial lamellæ subequal all around.

The Patellæ or limpets are not eaten in the United States, but in Europe, especially upon the British Coasts, there is a large consumption of them; roasted, boiled or made into soup, they are very palatable. They were eaten by primitive man, and the shells were formed into ornamental necklaces, occurring in the most ancient cromlechs or subterranean burial chambers. They are very extensively used as bait also; in Berwick alone, until the supply was exhausted, nearly twelve millions of limpets are said to have been gathered annually for this purpose—a process requiring alertness and skill, for, as Wordsworth says:—

“And should the strongest arm endeavor
The limpet from its rock to sever,
'Tis seen its loved support to clasp,
With such tenacity of grasp,
We wonder that such strength should dwell
In such a small and simple shell.”

“Bouchard-Chantreaux says that he had often seen limpets (*Patella vulgata*) crawling, especially just after the tide had gone out. The young limpet moves freely about, and shifts its quarters; but after attaining a growth of probably a few days, it affixes itself to a particular spot, which it only quits when covered by the sea, on the return of each tide. If it settles on a hard and rugged rock, the circumference of the shell is moulded to fit the irregular surface of its abode; the base of attachment is then bleached. Should the rock be soft, it scoops

out, by degrees, with its muscular foot a cavity of a greater or less depth. Specimens are not unfrequently found, on impure limestone, which are constricted or indented at the edges, in consequence of the excavation having been hindered by the greater hardness of one side of the spot occupied by these limpets. The animal feeds on small, delicate sea-weeds of a foliaceous kind, as well as on *Melobesia polymorpha*, that encrust the rocks at low-water, by means of its long tongue, which is coiled spirally, like the main-spring of a watch, set around with cogs. This instrument is thrust out from side to side, and when charged with food, it is withdrawn into the stomach, unloaded, and again put forth. The mark left on the face of a rock, coated with a film of the fine sea-weed mentioned above, by a limpet after grazing, resembles the track of a sea-worm; indeed, a late eminent geologist had a large slab thus marked cut out of the rock, and sent to him with great care, in order to publish the supposed discovery of a new Annelidan ichnolite in the old red sandstone. Fortunately, the mistake was pointed out to him before he proceeded further. Each limpet appears to have its own feeding-ground or pasturage; its tracks are sometimes numerous, and deviate in different directions. Mr. Peach has ascertained that it does not retire in the winter to deeper water, on the coast of Caithness, and that it always returns home before the ebbing tide leaves it dry. Its firm adhesion to the rock is extraordinary. In order to test the strength of its tenacity, Reaumur suspended a weight of 28 to 30 lbs. from the shell of a limpet attached to a stone. This weight it sustained for some seconds; less weight failed to overcome its resistance. He attributes the adhesive force not to muscular action, but to an invisible glue which exudes from the granulated base or sole of the foot. It may be also caused by the adaptation of the surface of this part of the animal to the frequent, although often minute, inequalities of the stone, although the glutinous and viscous fluid, which is secreted by numerous glands in the foot, appears to be the principal agent."—JEFFREYS, *British Conchology*.

PATINELLA, Dall. Shell solid, porcellaneous, with an erect sub-central apex. Foot bordered by a scalloped frill, interrupted only in front. *P. Magellanica*, Gmel. (lxxxiii, 23).

NACELLA, Schum. Shell with the apex submarginal, anterior; pellucid, thin or corneous. Animal with the branchial cordon complete before and behind, the laminæ persistent but diminishing in size before the head; sides of the foot with scalloped lappets. *P. cymbularia*, Lam. (lxxxiii, 24).

HELICION, Montfort. Shell ovate, radiately ribbed (pectinated); apex anterior, submarginal; aperture ovate, edge crenated. Branchial cordon interrupted in front; sides of the foot smooth. *P. pectinata*, Linn. (lxxxiv, 50).

HELCIONISCUS, Dall. Shell solid, heavy, moderately elevated, with a subcentral inconspicuous apex. Branchial cordon interrupted in front, ending abruptly on each side, at the anterior ends of the adductor; sides of foot and mantle-edge smooth; inner uncinus hardly raised above the level of the lingual ribbon, second lateral tooth largest. *P. exaratus*, Nutt. (lxxxiii, 25).

PATINA, Leach. (Nacella H. and A. Adams, in part. Ansates, Sowb.) Shell with the apex subterminal, anterior; smooth, thin, semipellucid or horny. Animal with the branchial cordon interrupted in front; teeth with the inner two series parallel, third series with a larger denticulate cusp, posterior, three uncini on each side the radula. *P. pellucida*, Linn. (lxxxiv, 51).

ANCISTROMESUS, Dall. Shell white, apex subcentral, obsoletely radiately ribbed. Animal blackish, with complete branchial cordon, the lamellæ being long and slender, subequal; sides of foot smooth; radula with a simple rachidian tooth, the two inner laterals on each side anterior to the third pair, which are large and quadridentate, uncini simple.

A. Mexicanus, Brod. is the largest living limpet, the shell attaining a length of from 8 to 14 inches. It is frequently used as a wash-basin in Central America, and inhabits the West Coast, extending northwards to Acapulco, etc.

METOPTOMA, Phillips. (Tryblidium, Lindström, 1880.) Shell like Helcion, with a broad but slightly or obsoletely marked scar below the apex, truncate or somewhat insinuated on the margin. Palæozoic; United States, Europe. *P. solaris*, Kon. (lxxxiv, 52).

The following subgenera of *Patella* occur in the work of Messrs. H. and A. Adams. They are not recognized by Mr. Dall on account of the insufficiency of their distinctive characters; like him I have placed them in the synonymy—but give their descriptions.

SCUTELLAstra, H. and A. Adams. Shell coarsely ribbed, the ribs causing long projections of the margin. *P. longicosta*, Lam. (lxxxiii, 26, 27).

CYMBULA, H. and A. Adams. Shell oblong, laterally compressed, with radiating striæ and recurved apex. *P. compressa*, Linn. (lxxxiii, 28).

OLANA, H. and A. Adams. Shell contracted in front; apex obtuse. *P. cochlear*, Born. (lxxxiii, 29).

LEPETOPSIS, Whitfield, 1882.

Type.—*L. Levettii*, White. Carboniferous; Indiana.

Shell patelliform, more or less regularly round or oval, apex subcentral, posterior to the middle and directed backward, the nucleus dextrally coiled; muscular imprint horseshoe-shaped, open (?) in front; consisting of an irregular narrow band which

expands more or less at the anterior extremities; surface of the shell marked by six very indistinct radiating lines, two anterior, two posterior, and two lateral.

ORDER POLYPLACOPHORA.

Animal symmetrical, with a broad foot; no eyes or tentacles; head extensible into a proboscis; mouth furnished with jaws and lingual ribbon; branchiæ posterior, marginal, between the mantle and foot; heart median; intestine straight, anus posterior; sexes united in the same individual.

Shell when present multivalve, consisting of eight separate pieces inserted upon the back of the animal and surrounded by a mantle-border.

FAMILY CHITONIDÆ.

Shell composed of eight separate transverse imbricating plates, lodged in a coriaceous mantle, which forms an expanded margin around them. Dentition (xii, 52).

The following description of the Chitones is illustrated, as to the shell, lxxxiv, 53, 55, 56; lxxxv, 54.

In all Chitons with exposed valves, the seven posterior valves are divided more or less plainly by lines radiating from the apex to the opposite anterior edge. The sculpture of the posterior triangular areas (aræ laterales) thus cut off is almost uniformly like that of the whole anterior valve and the part behind the apex (mucro) of the posterior valve. The central or anterior triangles (aræ centrales) are sculptured alike, but generally in a different pattern from the sides. The aræ laterales are usually raised a little above the rest. It is very rare that the bounding diagonal lines cannot be traced, and they usually correspond to the slit in the side-laminæ of insertion, which project into the zone or girdle, and are free from the peculiar porous superficial layer characteristic of the exposed test in the whole group of Chitons. This superficial layer usually projects over the anterior and posterior laminæ of insertion or teeth (dentes) in the first and last valves, forming what Dr. Carpenter terms the "eaves" (subgrundæ). These may exhibit the spongy character of the layer of which they are formed, or may be varnished over at their edges with a thin layer of true shelly matter, as in the Ischnoid group. In the typical Chitons they are short, leaving the teeth projecting; in the Mopaloids they are hardly developed, and in some groups they quite overshadow the teeth.

In many groups there is a small portion of peculiar sculpture marked off along the ridge of the median line of the back. This is the area jugali, and corresponds to the sinus or space between the inner terminations of the two anterior sutural laminæ which

pass forward from each of the posterior seven valves under the valve in front. The sutural laminae are also destitute of the porous layer. The sinus is either open, or part of the jugular area projects forward between the sutural laminae, forming a false apex; or a keystone-like piece, either solid, or fimbriated like the teeth of a comb, may exist between the laminae and partly fill the sinus. The sinus posticus is the wave, notch or indentation which in some genera is found in the posterior edge of the posterior valve. In some of the irregular Chitons posterior sutural laminae are found, but these are very exceptional.

In the vast majority of genera, the side-laminae of insertion have only one slit on each side of the valve; occasionally a valve may be abnormal in a regular species, and the number of slits in the anterior and posterior valves may vary within moderate limits.

The girdle (*zona*), which is distinct from the true mantle, is variously ornamented with scales, bristles, spines, down or hairs, either singly or combined, which exhibit most beautiful forms tolerably constant in generic groups, and worthy of a special and exhaustive research. These may be solid or hollow, shelly or keratose, single or combined in bunches, and in some forms are hollow and annulated, precisely like the setae of brachiopods. In certain genera they issue from pores, usually at the sutures, and these pores have a certain value as a systematic character, but much less than has been assigned to them by some authors.

The Chitons in the adult condition are destitute of eyes or tentacles, and exhibit evidences of degradation anteriorly. The intestine is straight and the anus is always median and posterior; on each side of it are the sexual openings or fenestrae. These may open by several slits or pores directly into the perivisceral cavity, or form the aperture of a sexual duct. The gills are composed of a row of branchiae, starting from near the tail, extending a third (posticæ), half (mediæ), or all the way (ambientes) towards the head, each leaflet of which corresponds to a whole branchial plume, such as is found in *Acmæa*. Each single gill is conical, with the lamellæ projecting inwards, somewhat resembling in outline the shell of *Carinaria*. The mantle, inside the coriaceous margin of the girdle, often forms a lamina of fringe. A lappet called the "veil" generally surrounds the front of the rostrum, which has sometimes a double veil. The muzzle is semicircular, usually plain, and exhibits a tendency to form a lobe at the two posterior corners. The radula is always present and, as in the limpets, is very long; lingual teeth three, median small, laterals large, with dentated hooks, uncini five, trapezoidal, one of them erect and hooked. Like the limpets Chitons possess a laminated crop before the true stomach. The nervous system beautifully worked out by Brandt in a paper singularly over-

looked by most writers, is also comparable with that of *Patella vulgata* (simultaneously examined and figured), though by no means identical. The cephalic ganglia appear to be suppressed, forming another evidence of the degeneration or want of development of the cephalic region of this group.

The above characters are mostly as given by Mr. Wm. H. Dall (*Proc. Nat. Mus.*, 1, 283), who has very carefully studied the Chitons. He has published an elaborate classification of the group, mainly based upon characters of the valves and their surrounding girdle—a classification which is largely founded upon the studies of the late P. P. Carpenter. I have adopted the groups of these eminent naturalists almost throughout, but not usually with the values originally assigned to them, believing that most of their genera had better, at least for the purposes of the present work, be considered subgenera. The Chitons are constituted an order, Polyplacophora, by Gill, Dall, etc., the main character of which is derived from the divided shell; this is the principal distinction from the limpets, with which these mollusks have many points of analogy. Hubrecht forms for the Chitons, etc., a class Amphineura, embracing the orders Solenogastres and Chitones.

CHITON, Linn.

Etym.—*Chiton*, a coat of mail.

Distr.—More than 250 species are known; they occur in all climates throughout the world; most abundant on rocks at low-water, but frequently obtained by dredging in 10–25 fathoms. Some of the small species range as deep as 100 fathoms. North and South America, West Indies, Europe, South Africa, Australia, New Zealand, and Sitka. Fossil, 50 sp. Silurian—*C. squamosus*, Linn. (lxxxv, 57).

The generic description is equivalent to that of the family.

Mr. Guilding says of the West Indian species (and his remarks will in most particulars apply to others), “They seem to feed entirely by night. Though they remain stationary during the day, when disturbed they will often creep away with a slow and equal pace, often sliding sideways, and creeping under the rocks and stones for concealment. If accidentally reversed, they soon recover their position by violently contorting and undulating the zone; and for defense they sometimes (when detached) roll themselves up like wood-lice. Some of the larger kinds, especially of *Acanthopleura*, are eagerly devoured by the lower orders in the West Indies, who have the folly to call them ‘beef;’ the thick fleshy foot is cut away from the animal and swallowed raw, while the viscera are rejected. We have here a large pale *Chiton*, which is said to be poisonous.” Ladies who are not good sailors, and are fond of trying new preventives against sea-sickness, may (if they can) swallow raw *Chitons*, and

so imitate the Iceland fishermen, who pretend that the "sea bugs" are an effectual remedy against this malady, and also that they quench thirst. Perchance the deglutition of these strange bolus might by anticipating the evil rob a sea-passage of its horrors.—JEFFREYS, *British Conchology*.

Section I.—Chitones Regulares.

Head- and tail-plates similarly articulated.

A. Leptoidea.

Insertion-plates obsolete or, if present, unslit.

(Extinct Forms.)

The secondary and tertiary Chitons all belong to recent genera. The following are all palæozoic. A large number of the fossils described as Chitons (for instance *Sulcochiton Grayi*, Ryckholt) are not mollusks; many of them being valves of Balani or fragments of isopod crustaceans.

HELMINTHOCHITON, Salter. Shell elongated, regular; mucro regular, subcentral; terminal valves not sinuated; apophyses unknown. *Distr.*—2 sp. Silurian, Devonian; Europe. *C. Griffithii*, Salter (lxxxv, 58).

GRYPHOCHITON (Gray), Carpenter. Shell elongated; lateral laminae none, suturals small, separated by a wide, simple sinus; mucro incurved like the beak of a Gryphæa; posteriorly and anteriorly strongly sinuated. *Distr.*—4 sp. Carboniferous; Belgium. *C. priscus*, Münster (lxxxv, 70).

CHONECHITON, Carpenter. Shell Leptoidal, the central valves like Gryphochiton, the last with posterior mucro, infundibuliform. *Distr.*—Carboniferous; Belgium. *C. viseticola*, Ryck. (lxxxv, 59).

PRISCOCHITON, Billings. Leptochiton, with posterior lamina excavated within. *Distr.*—L. Silurian; Canada. *C. Canadensis*, Billings (lxxxv, 64–66).

PTEROCHITON, Carpenter. Shell elongated, Leptoidal; valves laterally excavated, posteriorly acuminate; last valve regular, the mucro Ischnoidal; anterior valve (usually?) sinuated; apophyses large, sinus wide. *Distr.*—6 sp. Devon.; Ireland, Belgium, etc. *C. eburonicus*, Ryck. (lxxxv, 67).

LORICITES, Carp. Related to Lorica, from which it differs in the absence of laminae of insertion. Fossil. Type, *C. concentricus*, Koninek.

PROBOLÆUM, Carpenter. Shell Leptoidal, elongated, largely projecting; central valve with the central area extending in front of the jugum; anterior valve sinuate, posterior valve (?). Among recent forms this comes nearest to Katherina, but the difference is still extremely great. *Distr.*—Devonian of Vilmar. *P. cor-rugatum*, Sandb.

CYMATOCHITON, Dall. Leptochiton with the valves thrown forward. Differs from Probolæum in the valves being transverse instead of squared, and in the terminal valves being regular instead of waved. *C. Loftusianus*, King (lxxxv, 68, 69).

Recent Forms.

LEPTOCHITON, Gray. (Lepidopleurus, Risso. Craspedochilus, and Boreochiton, Sars.) Insertion-laminæ none; girdle or zone minutely sandy; sinus smooth, not laminated. Branchiæ short. *Distr.*—10 sp. Northern Seas, Kerguelen's Isl. Type, *L. asellus*, Lowe. *L. cancellatus*, Sowb. (lxxxv, 71). Only 2 out of the 25 species cited by Adams really belong here.

DESHAYESIELLA, Carpenter. Valves curved forwards; mucro planate; zone or girdle spiculose; insertion-plates none; sutural laminæ triangular, raised. *C. (Leptochiton) curvatus*, Cpr.

HANLEYIA, Gray. Anterior valve with an unslit insertion-plate; other valves destitute of the plates. *Distr.*—Mostly northern; one from deep waters, Gulf of Mexico. *C. debilis*, Gray.

HEMIARTHURUM, Carpenter. Insertion-plates present on all the valves, but entire without slits. *H. setulosum*, Carpenter.

MICROPLAX, H. Adams. Resembling Chitonellus externally; submerged laminæ unslit, entire, fused in an undistinguishable manner with the parts which usually constitute the sutural laminæ. *M. Grayi*, Ad. and Ang.

B. Ischnoidea.

Insertion-plates sharp, smooth, fissured; with eaves.

** No pores on girdle.*

TRACHYDERMON, Cpr. (Lepidopleurus sp., Auct. Craspedochilus, Sars.) Insertion-laminæ acute, smooth; valves within and without exactly like Ischnochiton; zone or girdle not poriferous, granulated by very minute scales. Branchiæ short. This name was originally proposed as a subgenus of Ischnochiton to include Gray's second section, "mantle-scales minute, granular." In all other conchological characters the group accords with that genus, but the animal differs in having the gills either entirely posterior or reaching forward from the tail only to about the middle of the foot, while in Ischnochiton and Chiton they travel to its anterior extremity. These characters indicate a transition between the Ischnoid and Leptoid Chitons by means of Trachydermon and Tonicella. *Distr.*—Chiefly northern. *C. ruber*, Lowe (lxxxv, 72).

TRACHYRADIA, Cpr. Central valve doubly or many-cleft. *C. fulgetrum*, Reeve.

CALLOCHITON, Gray. Laminæ broken up into very numerous teeth rising out of spongy eaves, and having a tendency to

become propped outside; sinus a mere wave in the united bodies of the sutural laminae; mantle reticulated with peculiar bodies, the tips of which appear like diamond-shaped scales, and which are unlike the armature of any other Chiton. *C. lævis*, Mont. (lxxxv, 73).

STEREOCHITON, Cpr. Girdle coriaceous, sparsely downy. *S. castaneus*, Wood.

TONICELLA, Carpenter. Valves, mucro, laminae and sinus usually as in *Ischnochiton*; zone as in *Tonicia*, coriaceous, smooth or nearly so. The genus *Tonicia*, Ads. and Gray, to which the species of *Tonicella* have often been referred, has pectinated insertion-plates and ambient gills like the typical Chitons, while *Tonicella* has sharp plates and short rows of gills. The two groups also differ in dentition. *Distr.*—Mostly Northern; Atlantic, California. *T. marmoreus*, Fabr.

SCHIZOPLAX, Dall. (*Tonicia* sp., H. and A. Adams.) Shell and zone like *Tonicella*; central valves with a median slit. Branchiae subambient. *Distr.*—*S. Brandtii*, Midd. Alaska, Siberia.

LEPTOPLAX, Carpenter. Valves thin, smooth, partly immersed; insertion-laminae acute, terminals few-fissured, but regular; sinus not dentate; mucro median. *C. coarctatus*, Sowb. (lxxxv, 74). May be considered a partially covered *Tonicella*.

CHÆTOPLEURA, Shuttleworth. (*Acanthopleura*, Gray.) Shell like *Ischnochiton*; insertion-plates regular, branching; middle valve with one, anterior and posterior with many slits; teeth sharp, normal; eaves moderate; sinus broad, or minute; girdle hairy. Gills encircling. *Distr.*—Several sp. *C. Peruvianus*, Lam. (lxxxv, 75).

MAUGERELLA, Cpr. Middle valve with two slits; eaves projecting; girdle with short, striated, shelly bristles. *C. conspicuus*, Carp.

SPONGIOCHITON, Carpenter. Valves partly immersed; laminae acute, Ischnoid; sinus large, smooth; mucro median, planate; zone spongiferous, produced in front. May be considered a partially covered *Chætopleura*. *C. productus*, Cpr.

ISCHNOCHITON, Gray. (*Lepidopleurus*, H. and A. Adams.) Shell thin; laminae of insertion regular, acute, neither pectinate nor serrate; eaves (subgrundæ) large; sinus usually smooth; girdle squamose, the squamæ generally striate. Branchiae elongated. *C. longicymba*, Blainv. (lxxxv, 76).

The main character of this group, which includes by far the largest number of species of any single group of Chitons, consists in the row of sharp, smooth insertion-teeth, surrounded by more or less projecting eaves, and in the scaly girdle.

Dr. Carpenter has proposed the following eight subgenera, which I retain as sections:

ISCHNOCHITON (restricted). Scales transverse, flattened, somewhat imbricated, generally striated.

ISCHNORADSIA, Cpr. (ex Shuttlew.). Scales striated; central valves with many slits. *C. trifidus*, Cpr.

LEPIDOPLEURUS, Cpr. Scales solid, imbricated, smooth. *C. Mertensii*, Cpr.

LEPIDORADSIA, Cpr. Similar to the last, with many slits in central valves. *C. Australis*, Sowb.

STENOPLAX, Cpr. Body elongate; scales elongate, chaffy, striated, irregular and crowded. *C. limaciformis*, Sowb. (lxxxv, 96).

STENORADSIA, Cpr. Like Stenoplax, with numerous side-slits. *C. Magdalensis*, Hinds (lxxxv, 77).

ISCHNOPLAX, Cpr. Like Stenoplax, but with occasional large scales rising above the rest, and a multitude of short striated bristles; mucro raised, subposterior.

HETEROZONA, Carpenter. Body elongate; two kinds of rather solid, striated scales.

CALLISTOCHITON, Cpr. Insertion-plates regular, branching; middle valve with one, anterior and posterior with many slits; teeth excurved, plumate; eaves projecting, long; sinus broad, shallow, laminate; girdle narrow, with small scales; gills encircling.

* * *With girdle-pores.*

CALLISTOPLAX, Cpr. Shell as in Callistochiton, poriferous girdle naked. *C. retusus*, Sowb. (lxxxv, 78).

ANGASIA, Cpr. (Hanleyia, Ad. and Angas, not Gray.) Shell like Chætopleura, but the eaves small; girdle minutely squamulose-pilose, fasciculated at the sutures. *A. tetrica*, Cpr.

NEWCOMBIA, Cpr. Insertion-plates regular, branching; middle valve with one, anterior and posterior with many slits; teeth solid, not propped; eaves short; sinus rounded, simple; girdle fleshy, with long, hairy bristles.

CERATOZONA, Dall. Shell like Chætopleura, but the teeth raised, eaves short; girdle smooth, fasciculated around the sutures and margin. This differs from all other hairy or spiny Chitons, at all nearly related to it, in the mantle-ornaments not being inserted into sockets, but being extensions of its surface. *C. Guildingii*, Reeve (lxxxv, 79).

PALLOCHITON, Dall. Like Nuttallina; zone downy; central laminae unfissured. This section unites in a form resembling Nuttallina, some of the features of Middendorfia, from which the girdle differs in being spongy and covered with soft hairs instead of short shelly bristles. *O. lanuginosus*, Cpr.

C. Lophyroidea.

Insertion-plates broad, pectinated, projecting backward.

CHITON, Lam. Girdle covered with distinct scales; anterior and posterior valves with many slits, middle valve with one; teeth blunt, serrate; eaves short, spongy; sinus squared, denticulate; gills ambient.

BADSLIA, Gray. Teeth in middle valve two or more; differs also from Chiton in having side-slits. *C. Barnesii*.

TONICIA, Gray. Anterior and posterior valves with many slits, middle with one; teeth sharp, serrate; eaves short, spongy; sinus squared, denticulate; girdle smooth or downy; gills encircling. *C. elegans*, Frém. (lxxxv, 80).

FANNETTIA, Dall. Insertion-plates regular, branching; middle valve with one, anterior and posterior with nine slits; teeth sharp, serrate, long; eaves very short, sinus squared, denticulate; girdle smooth, spreading; gills encircling.

EUDOXOCHITON, Shutt. Insertion-plates unfissured; teeth blunt, fimbriate; eaves short; sinus small, laminae united; girdle hairy.

CRASPEDOCHITON, Shutt. Insertion-plates regular; middle valve with one slit, anterior with five, posterior with eight; girdle very minutely asperulate. The posterior valve is fimbriated in the middle. A doubtful group.

D. *Acanthoidea*.

Insertion-plates thrown forward.

* *Plates broad, pectinated.*

SCLEROCHITON, Cpr. Zone as in Enoplochiton; laminae obtuse, pectinate; sinus waved, smooth. Most like Enoplochiton, from which it differs in the articulation of the tail-plate and the sub-central mucro.

** *Plates sharp, grooved outside.*

ACANTHOPLEURA, Guilding. (Lucia, Gould.) Anterior and posterior valves with many slits, middle with one; teeth blunt, grooved; eaves projecting, grooved; sinus large, waved; girdle with calcareous bristles. *C. spiniger*, Sowb. (lxxxvi, 94).

FRANCISIA, Carp. Valves partly immersed, planate; central laminae with several slits; sinus lobed. Bears the same relation to Acanthopleura that Fannettia does to Tonicia, with the additional peculiarity of Radsoid nicks in the central valves. *C. spinosus*, Brug. (lxxxv, 81).

*** *Plates sharp, smooth.*

DINOPLAX, Carpenter. Armor heavy, alate; mucro not elevated, submedian; laminae separate, acute, smooth; last valve extending forwards; sinus small; girdle coriaceous, spinulose in fascicles. *C. gigas*, Linn. (lxxxv, 88).

MIDDENDORFIA, Cpr. (Dawsonia, Cpr.) Armor and girdle as in Acanthopleura; laminae acute, rugose exteriorly; the sinus planate, not laminated. *C. Poli*, Phil.

BEANELLA, Dall. (Beania, Cpr., not Johnstone.) Armor and girdle intermediate between Acanthopleura and Ischnochiton; mucro submedian; the laminae acute; the girdle scaly, subspinose, scarcely imbricated. *C. Rissoi*, Cuming.

ARTHURIA, Carp. Armor thin; valves waved; mucro posterior, produced; laminae acute, smooth; last valve extending forwards, sinus planate, laminate, smooth; girdle coriaceous, smooth or downy. *C. filusus*, Cpr.

NUTTALLINA, Cpr. (Named in honor of Prof. Thomas Nuttall, a pioneer collector of Californian shells.) Shell elongated, valves projecting anteriorly; mucro posterior, elevated; laminae acute, smooth, elongate; central valves bifissate; sinus not laminated, planate; girdle spinose. Differs from Acanthopleura in the smoothness of the sharp teeth, in their great length and Radsoid slitting; in the thrown-back mucro, which often projects beyond the margin; in the throwing forward of the rest of the shell, as in Katherina, and in the deep spongy flat sinus which interrupts the sutural laminae. *C. scabra*, Reeve (lxxxvi, 85).

PHACELLOPLEURA, Guild. Posterior valve thrown forward, having six or more slits; anterior valve with five slits; middle, one slit; teeth very long, sharp, smooth; eaves very short; sinus narrow, laminae separated; girdle thin, downy, wide, with sutural pores. *C. porphyriticus*, Reeve.

Section II.—*Chitones irregulares*.

Tail-plate abnormal or with a sinus behind.

E. *Schizoidea*.

Tail-valve fissured.

LORICA, H. and A. Adams. Insertion-plates regular, posterior valve slit between two ridges; anterior valve with many slits, middle with one; teeth blunt, rugose; eaves moderate; sinus narrow, girdle slit behind, smooth, scaly. *C. cimolius* (lxxxvi, 86).

AULOCHITON (Shuttl.), Cpr. Mucro posterior, slightly sinuate; sinus lobed; girdle covered with small scales, produced in front. *C. Angasi*, H. Ad.

SCHIZOCHITON, Gray. Insertion-plates straight forward, deep slit, slits many in anterior valve, one to two in middle, few in posterior valve; teeth sharp, long; eaves small; sinus narrow, very deep; girdle slit behind, covered with minute spiculæ. *C. incisus*.

F. *Placiphoroidea*.

Tail-valve unslit, internally ridged, mucro nearly terminal.

ENOPLOCHITON, Gray. Insertion-plates straight forward, flat behind; anterior valve with many slits, middle with one, posterior with none; teeth serrate; eaves moderate; sinus deep, lobed; girdle large, with separate scales, and bristles between. *C. Coquimbensis*, Fremb. (lxxxvi, 87).

ONITHOCHITON, Gray. Insertion-plates regular, flat behind; anterior valve with many slits, middle with one, posterior with none; teeth serrate; eaves deeply furrowed; sinus moderate, lobed; girdle with chaffy hairs. *C. Lyellii*, Sowb. (lxxxvi, 82).

PLACIPHORA, Gray. Insertion-plates regular, ribbed behind; anterior valve with many slits, middle with one, posterior with none; teeth slightly propped; eaves small; sinus small; girdle hairy, with regular pore-tufts. *C. Carmichaelis*, Gray.

FREMBLYA, H. Adams. Valves regular, ribbed behind; the middle with one, anterior with many, posterior with no slits; teeth excurved; eaves small; sinus broad, shallow; girdle hairy, with regular pore-tufts. Distinguished by its excurved teeth. *C. Collei*, H. Ad.

EUPLACIPHORA, Shutt. Sinus wide, planate; girdle set with bristles, not fasciculated.

GUILDINGIA, Cpr. Valves partly immersed; girdle emarginate behind. *C. petholatus*, Sowb. (lxxxvi, 89).

G. *Mopaloidea*.

Tail-valve with posterior sinus and one slit on each side.

MOPALIA, Gray. Shell regular; laminae lengthened; anterior valve with six or more slits, the others with a single slit; last valve sinuate behind; sinus narrow; mucro median, depressed; sutures indented; girdle wide, bristly, sometimes fissured behind, sometimes projecting anteriorly. *C. Blainvillei*, Brod. (lxxxvi, 90).

PLACIPHORELLA, Cpr. The hairs or part of them issuing in fasciculi from sutural pores. *C. velata*, Cpr.

KATHERINA, Gray. Armor small; girdle smooth, much expanded in the sutures; laminae greatly projecting anteriorly, the posterior valve lobate; sinus deep, spongy. Branchiæ encircling. *Distr.*—*C. tunicatus*, Wood (lxxxvi, 91). W. Coast America, California to Alaska, Kamtchatka.

ACANTHOCHITON, Leach. Insertion-plates thrown forward, laminated; anterior valve with five slits, middle and posterior valves each one; teeth long, sharp, smooth; eaves small; gills median; sinus deep, broad, spongy; girdle hairy, with long, fasciculated spiculæ. *C. fascicularis*, Auct.

MACANDRELLUS, Cpr. Valves partly immersed; mucro Ischnoidal; posterior lamina rugosely lobate; lateral area depressed. *C. plumens*, Cpr.

STECTOPLAX, Cpr. Valves two-thirds immersed.

NOTOPLAX, H. Adams. Tail-plate crenate behind; first valve with five, last with two, middle with one slit; teeth crenate, sharp, smooth; eaves minute; sinus deep, narrow; gills crowded with spicules, and with sutural pores.

H. *Cryptoidea*.

With double sutural laminae.

CRYPTOCONCHUS, Guilding. Insertion-plates regular, variable behind; anterior valve with five slits, middle one, posterior irregular; teeth very long, smooth; eaves minute; sinus deep, arched; girdle smooth, tufted; valves nearly covered; gills one-third. *C. porosus*.

AMICULA, Gray. (*Symmetrogephyrus*, Midd. *Stimpsoniella*, Cpr.) Shell regular; exposed valves small, mucronate or subcordate; posterior sutural laminae large; girdle more or less pilose, sometimes poriferous. Branchiæ median in the typical group. *C. Pallasii*, Midd. (lxxxvi, 92).

CHLAMYDOCHITON, Dall. Branchiæ encircling. The Amiculæ are provided with pores bearing fasciculi of bristles of a soft or horny character, and which, while often irregularly disposed or even almost entirely absent (in particular individuals), have a tendency to arrange themselves in two rows on each side of the median line, one row behind the exposed point of the valve, and another near its submerged lateral posterior angle, on each side. The mantle is also provided with a coating of fine, chaffy, deciduous scales. *C. amiculatus*, Pallas (lxxxvi, 93).

CRYPTOCHITON, Midd. and Gray. Valves entirely immersed in the girdle, which is minutely fasciculately pilose. Branchiæ encircling. *C. Stelleri*, Midd. (lxxxv, 83) is the largest of the Chitons, attaining a length of eight inches. The valves are entirely covered, so that their outline even is not indicated in fresh specimens, although plainly marked in those which have been dried. The Aleutians and Indians eat the foot and softer parts, in the raw state.

I. *Chitonelloidea*.

Tail-plate funnel-shaped, laminae thrown forward.

CHITONELLUS, Blainville.

Insertion-plates very sagittate; slits in anterior valve 5, in middle 0-1, in posterior none; teeth very short, except at sutures; eaves distinct; sinus very deep and narrow; girdle crowded with bristles, no tufts; gills posterior. The species enjoy considerable powers of locomotion compared with other groups of the family. *C. fasciatus*, Quoy (lxxxv, 95).

CRYPTOPLAX, Gray. Middle valve without slits; girdle with crowded bristles, tufted.

CHONEPLAX, Cpr. Animal creeping, rather long; exposed valves small, contiguous; last one infundibuliform; mucro recurved, terminal; laminae as in *Katherina*, but obsoletely slit; girdle as in *Acanthochiton*. *C. striatus*, Sowb. (lxxxv, 84).

CHITONISUS, Cpr. Girdle not poriferous. Based on *C. striatus*

and *C. strigatus*, Sowb., which are figured as without pores. In the former the valves are separated, in the latter they touch. The species need examination to confirm the accuracy of the figures, but it is probable that there are both poriferous and not poriferous.

FAMILY NEOMENIIDÆ.

The characters of the family are derived from those of the principal genus. It is one of the lowest forms of mollusks, being without many of the organs typifying its order.

Neomenia gorgoniophila, Kowalewsky, creeps somewhat like Nemertes; it sometimes leaves the water, and advances on a dry surface until it dies by exsiccation. When stopped by an obstacle, it creeps backwards.

NEOMENIA, Tullberg.

Syn.—*Vermiculus*, Dalyell. *Solenopus*, Sars.

Distr.—5 sp. Norway, Mediterranean.

Sexes united; no tentacula, no eyes, no radula, no jaw, no shell; body more or less worm-shaped; foot long, narrow, entirely hidden by the mantle; gills at the hinder end of the animal, retractile; heart rather developed; body-cavity entirely filled with entrails; generative organs situated along the back, above the stomach and intestine; nervous system composed mainly of a suprapharyngeal circle, with cerebral ganglion, and of two pedal ganglions.

PRONEOMENIA, Hubrecht.

Distr.—*P. Sluiteri*, Hubrecht. Nova Zembla.

Body cylindric, calcareous spicula of the epidermis enveloped by a very thick cuticle. A small radula, and distinct salivary glands. A gland near the vent, at the hinder end of the animal, is considered to be the organ of Bojanus. The lateral glands described by Tullberg are probably oviducts. The glands on both sides of the vent seem to be analogous to a byssal gland.

ORDER NUCLEOBRANCHIATA.

Pelagic animals swimming by means of fin-like lobes of the foot; with or without shells, the latter being transparent, glassy.

The respiratory and digestive organs form a sort of nucleus on the posterior part of the back, whence the name.

The abdomen, or visceral mass, is small, whilst the anterior part of the body (or cephalo-thorax, M. Edwards) is enormously developed. The proboscis is large and cylindrical, and the tongue armed with recurved spines. The alimentary canal of

Firola is bent up at a right-angle posteriorly on the dorsal side; in Atlanta it is recurved, and ends in the branchial chamber. The heart is prosobranchiate, although in Firola the auricle is rather above than in front of the ventricle, owing to the small amount of the dorsal flexure.

The nucleobranchs, and especially those without shells, "afford the most complete ocular demonstration of the truth of Milne Edwards' views with regard to the nature of the circulation in the Mollusca. Their transparency allows the blood-corpuscles to be seen floating in the general cavity of the body—between the viscera and the outer integument—and drifting backwards to the heart; having reached the wall of the auricle they make their way through its meshes as they best can, sometimes getting entangled therein, if the force of the heart has become feeble. From the auricle they may be followed to the ventricle, and thence to the aorta and pedal artery, through whose open ends they pour into the tissues of the head and fin."—HUXLEY.

Such delicate and transparent creatures would hardly seem to need any special breathing organ, and, in fact, it is present or absent in species of the same genus, and even in specimens of the same species. Carinaria has fully-formed branchiæ; in Atlanta they are sometimes distinct, and wanting in others; in Firoloides they are only indicated by a ciliated subspiral band. The larvæ are furnished with a shell, and with ciliated vela.—GEGENBAUER.

The nucleobranchs are diœcious; some individuals (of Firola) have a leaf-like appendage, others a long, slender egg-tube depending from the oviduct, and regularly annulated. The larvæ are furnished with a shell and with ciliated vela.—GEGENBAUER.

The nervous system is remarkable for the wide separation of the centres. The buccal ganglia are situated considerably in front of the cephalic, and the pedal ganglia are far behind, so that the commissures which unite them are nearly parallel with the œsophagus. The branchial ganglia are at the posterior extremity of the body, as in the bivalves. The eyes are hour-glass shaped, and very perfectly organized; the auditory vesicles are placed behind, and connected with the cephalic ganglia; they each contain a round otolite, which sometimes seems to oscillate.—HUXLEY.

FAMILY FIROLIDÆ.

Animal elongated, cylindrical, translucent, furnished with a ventral fin, and a tail-fin used in swimming; gill exposed on the posterior part of the back. No shell.

The genus *Sagitta*, Q. and G., sometimes referred to this family, is an articulate animal.—HUXLEY.

FIROLA, Peron and Lesueur.

Syn.—Pterotrachæa, Forsk. Anops; d'Orb.

Distr.—14 sp. Atlantic, Mediterranean, Pacific. *F. Quoyana*, d'Orb. (lxxxvi, 97).

Animal fusiform, elongated, with a long, slender, proboscidi-form head; fin narrowed at the base, usually furnished with a small sucker; tail elongated, keeled, sometimes pinnate; nucleus prominent; branchial processes numerous, conical, slender; tentacles very short and conical; eyes black and distinct, protected by a rudimentary eyelid; lingual ribbon oblong. The female *Firolæ* have a long moniliform oviduct. *Anops Peronii*, d'Orbigny, described and figured as having no head (!), was probably a mutilated *Firola*. "Such specimens are very common, and seem just as lively as the rest."—HUXLEY.

FIROLOIDES, Lesueur. (Cerophora, d'Orbigny.) Body cylindrical; head tapering, furnished with two slender tentacles; nucleus at the posterior extremity of the body, with or without small branchial filaments; egg-tube regularly annulated; tail-fin small and slender, ventral fin with or without a sucker. *Distr.*—6 sp. Atlantic, Mediterranean. *F. Gaimardi*, Orb. (lxxxvi, 98).

FAMILY CARINARIIDÆ.

Animal with pedunculated nucleus, covered by a glassy conical shell, from the margin of which project the branchiæ. Dentition (xii, 42).

CARINARIA, Lam.

Etym.—*Carina*, a keel. *Syn.*—*Tithyonia*, Cavolini.

Distr.—8 sp. Tropical and subtropical seas. Fossil, 1 sp. Miocene; Turin. *C. fragilis*, Bory (lxxxvi, 99). *C. vitrea*, Lam. (lxxxvi, 100).

Shell hyaline, symmetrical, limpet-shaped, with a posterior, subspiral apex and a fimbriated dorsal keel; nucleus minute, dextrally spiral.

Animal (lxxxvi, 99) large, translucent, granulated; head thick, cylindrical; lingual ribbon triangular, teeth increasing rapidly in size, from the front backwards; tentacles long and slender, eyes near their base; ventral fin rounded, broadly attached, with a small marginal sucker; tail large, laterally compressed; nucleus pedunculated, covered by the shell, gills numerous, pinnate, projecting from beneath the shell.

They feed on small Acalephæ, and probably on the Pteropoda; Mr. Wilton found in the stomach of a *Carinaria* two fragments of quartz rock, weighing together nearly three grains. The sucker on the fin of this and the preceding genus was formerly supposed to be characteristic of the male, but it has recently been found well-developed on female individuals. Mr. Arthur

Adams, in the delightful narrative of the "Voyage of the *Samarang*," says of these animals:

"When fresh taken, I have seen both the *Carinariæ* and *Atlantæ* swim with their bodies in every position, on their sides, on their backs, and with the foot downwards. The *Carinariæ* are swift and rapid in their movements, and dart forwards by a continuous effort, moving their foot and caudal appendage from side to side, as a powerful natatory organ, and do not progress by sudden jerks, like the *Atlanta* and *Hyalæa*. The true analogue of the foot of gastropods in *Atlanta* and *Carinaria* is the sucking disk, but its use is circumscribed to that of enabling the animal to anchor itself temporarily to floating bodies when fatigued. The shell of *Carinaria* covers only a small portion of the body, defending the more delicate organs, and in this we see a wise provision for permitting these pelagic mollusks to move freely about, without being encumbered with a dense, heavy skeleton."

CARDIAPODA, d'Orbigny.

Etym.—*Cardia*, heart, *pous*, foot.

Syn.—*Carinaroides*, Eyd. and Souleyet.

Distr.—5 sp. Atlantic. *C. placenta*, Eyd. (lxxxvi, 1-3).

Shell minute, cartilaginous; peristome expanded and bilobed in front, enveloping the spire behind.

Animal like *Carinaria*, tail simple, acuminate.

FAMILY ATLANTIDÆ.

Animal furnished with a well-developed shell, into which it can retire; gills contained in a dorsal mantle-cavity; lingual teeth similar to *Carinaria*. Dentition (xii, 41).

Shell symmetrical, discoidal, sometimes closed by an operculum.

ATLANTA, Lesueur.

Syn.—*Steira*, Esch.

Distr.—18 sp. Warmer parts of the Atlantic, Canary Islands. *A. turriculata*, d'Orb. (lxxxv, 4, 5). Fossil, 1 sp. Tertiary; San Domingo.

Shell minute, glassy, compressed and prominently keeled; nucleus dextrally spiral; aperture narrow, deeply notched at the keel. Operculum ovate, pointed, lamellar, with a minute, apical, dextrally spiral nucleus.

Animal three-lobed; head large, subcylindrical; tentacles conical, with conspicuous eyes behind them; ventral fin flattened, fan-shaped, furnished with a small, fringed sucker; tail pointed, operculigerous.

"The *Atlanta*," writes Mr. Arthur Adams, "is quite a sprightly little mollusk, probing every object within its reach, by means

of its elongated trunk, twisting its body about, and swimming in every direction by the lateral movements of its vertical, dilated foot. I have frequently seen them descend to the bottom of the glass vessel in which they were kept, fix themselves there in the manner of a leech, by their sucking disk, and carefully examine the nature of their prison-house by protruding the front portion of the foot in every direction."

They swim shell downwards, with sudden jerks, by means of their compressed and fin-like foot.

OXYGYRUS, Benson.

Syn.—Ladas, Cantraine. *Helicophlegma*, d'Orb.

Distr.—4 sp. Atlantic, Mediterranean. *O. Keraudrenii*, Rang (lxxxvi, 6, 7).

Shell milky, narrowly umbilicated on both sides; nucleus not visible; back rounded, keeled only near the aperture; body-whorl, near the aperture, and keel cartilaginous; no apertural slit. Operculum trigonal, lamellar.

SUBCLASS OPISTHOBRANCHIATA.

Branchiæ exposed, or protected by a fold of the mantle and situated at the posterior centre of the back, and never in a cervical cavity. Sexes united. Some have an internal or external spiral or patelliform shell, testaceous or membranous, others are without shell.

The mollusks of this subclass may be termed sea-slugs, since the shell, when it exists, is usually small and thin, and wholly or partially concealed by the animal. When alarmed or removed from their native element, they retract their gills and tentacles, and present such a questionable shape that the inexperienced naturalist will be likely enough to return them, with the refuse of the dredge, into the sea. Their internal structure presents many points of interest; in some the gizzard is armed with horny spines, or large shelly plates; in others the stomach is extremely complicated, its ramifications and those of the liver being prolonged into the papillæ, which are said to be branches of the respiratory organ. The tongue is armed, but the number and arrangement of the lingual teeth is exceedingly variable, even in the same family; usually the dental membrane is broad and short, with many similar teeth in each row.

The alimentary canal terminates more in the rear of the body than in the other univalve shell-fish. The gills are behind the heart, and the auricle behind the ventricle; conditions which characterize the embryonic state of the mollusca generally.

Comparatively little is known of the geographical distribution of these animals; they have been found wherever the requisite search has been made, and are probably much more numerous

than at present estimated. Considerable additions, however, have been made to our knowledge on this subject by the researches of Kelaart in Ceylon and A. Adams in the Chinese seas. The shell-bearing genera flourished in the period when the secondary strata were deposited. The living species are chiefly animal-feeders, preying on other shell-fish and on zoophytes.

ORDER TECTIBRANCHIATA.

Animal usually provided with a shell, both in the larval and adult state; branchiæ covered by the shell or mantle.

FAMILY PHILINIDÆ.

Shell usually present, sometimes wanting, internal, bulliform, but slightly spiral, usually not forming a single whorl; it is concealed under the lateral margins of the foot.

Teeth, central none; lateral one or two, large, hooked. Cephalic disk oblong or subquadrate, without tentacular lobes; eyes none, or, if present, sessile on the head; mantle covering and concealing the shell; foot not produced posteriorly, the sides dilated, thick and fleshy; gizzard armed with calcareous plates.

PHILINE, Ascanias.

Syn.—Bullæa, Lam. Megistoma, Gabb. Utriculopsis, Sars.

Distr.—20 sp. West Indies, Boreal Atlantic, Mediterranean, East Indies. Fossil, 7 sp. Eocene. *P. aperta*, Linn. (lxxxvii, 14, 15).

Shell internal, white, translucent, oval, slightly convoluted, spire rudimentary.

Animal pale, slug-like; mantle investing the shell; head oblong; eyeless; foot broad; lateral lobes large, but not enveloping; tongue with two or four series of sickle-shaped uncini; gizzard with three longitudinal shelly plates. Egg-capsules ovate, in single series on a long spiral thread; fry with a ciliated head-veil and an operculated, spiral shell.—Lovén.

The animal is blind, like most creatures that seek their food by burrowing. They frequent mud-flats and slimy banks at the entrances of rivers, which they perforate near the surface, and probe with their flattened heads for the small bivalves which constitute their prey; these they seize and swallow entire, breaking their shells by means of their testaceous, muscular gizzards.

CHELIDONURA, A. Adams. (Hirundella, Gray.) Shell concealed; outer lip produced posteriorly into a spur; columellar border inflected. Animal with enveloping side-lobes; mantle with two appendages behind, like the lateral processes of Hyalæa. *P. hirundinaria*, Quoy (lxxxvii, 16, 17).

PHANEROPHTHALMUS, A. Ad.

Syn.—*Xanthonella*, Gray.

Distr.—*P. luteus*, Quoy (lxxxvii, 18, 19).

Shell oval, convex, pointed behind, columella-margin with a curved process. Animal long, cylindrical, head with short tentacular lobes, eyes in middle of disk, lateral lobes enveloping.

CRYPTOPHTHALMUS, Ehrenberg.

Distr.—*C. olivaceus*, Ehr. (lxxxvii, 20). Red Sea.

Shell scarcely convolute, fragile, oval, convex, without spire or columella.

Animal semicylindrical, head with short tentacular lobes, eyes small, concealed under the lateral margins of the head, mantle and lateral lobes enveloping the shell.

PHILINOPSIS, Pease, 1860.

Distr.—2 sp. Sandwich Isles. *P. speciosa*, Pease.

Shell white, fragile, pellucid, with a curved callous apex. Head-disk large, oblong-oval or triangular, not extending in advance of the foot; body truncated behind, and the truncation surrounded by an undulated or crenated crest; eyes not visible; mouth proboscidiiform between cephalic disk and foot, with or without one pair of tentacles on sides of the mouth; foot large, rounded and reflected at the sides; branchial plume near the posterior end of the body, and curving around between the truncated end of the foot.

VOLVATELLA, Pease.

Distr.—*V. fragilis*, Pease. Sandwich Islands.

Shell convolute, subpyriform; aperture wide anteriorly, contracted posteriorly and produced, forming a circular aperture.

Animal. Mantle concealed; cephalic disk quadrate; tentacular lobes produced from the corners; anal aperture posterior; foot small and triangular.

LINTERIA, A. Adams.

Syn.—*Smaragdinella*, A. Ad. *Glaucanella*, Gray.

Example.—*L. viridis*, Rang (lxxxvii, 21).

Shell oval, depressed, slightly spiral, greenish; aperture very large, canaliculated behind; inner lip with a spiral spoon-shaped process.

Animal partially investing the shell; eyes sessile on the middle of the frontal disk; mantle included within the shell, ending posteriorly in a thickened lobe; foot with the side-lobes free, not united to the head, enlarged in the form of wings which unite behind and cover a portion of the shell.

Amphibious, living on moist rocks within reach of the spray,

and on rocks weeping fresh water near the sea-shore. Both animal and shell are of a glaucous green color.

NONA, H. and A. Adams. Shell white, fragile; outer lip produced into a wing behind. *L. Algiræ* (lxxxvii, 22).

SCAPHANDER, Montfort.

Etym.—*Scaphe*, boat, *aner*, man.

Distr.—13 sp. United States, Norway, Britain, Mediterranean on sandy ground, 50 fathoms. Fossil, 8 sp. Eocene.—*S. lignarius*, Linn. (lxxxvii, 23).

Shell oblong, convolute; spirally striated; aperture much expanded in front; spire concealed; epidermis thick; lingual teeth 1·0·1, crested.

Animal with a large oblong head, destitute of eyes; foot short and broad; lateral lobes reflected, but not enveloping the shell; gizzard with two large trigonal plates and a small narrow transverse plate. It feeds on *Dentalium entale*.

AGLAIA, Renier.

Syn.—*Acera*, Cuvier. *Eidothea*, Risso. *Doridium*, Meckel.

Distr.—3 sp. South Europe. *D. membranaceum*, Meck. Mediterranean.

Animal oblong, truncated behind, the angles produced and dilated or filiform; head ovate-oblong, retuse in front; side-lobes expanded, wing-like; mantle investing a rudimentary, membranous shell.

GASTROPTERON, Meckel.

Distr.—*G. Meckelii*, Bl. (lxxxvii, 24). Mediterranean.

Animal oval, with side-lobes developed into wing-like expansions, meeting and uniting behind; cephalic disk triangular, obtuse in front, pointed behind, eyes centrally immersed; lingual teeth 5·1·5; mantle (?), branchial plume exposed on the right side; reproductive orifice in front of the gill, excretory opening behind it. Shell almost microscopic.

[ATLAS, Lesueur.

Referred to this family by several systematists, is a larval creature, and not of a mollusk —MACDONALD.]

FAMILY TORNATELLIDÆ.

Animal generally perfectly retractile, but mostly of large size when expanded; foot thick, reflexed on the sides; head broad, very often forming a flat disk, with or without other appendages; tentacles broad, thick, united at base; eyes sessile near the base. Dentition, laterals numerous, uniform, in diverging cross series, rachidian teeth wanting (xiii, 68).

Operculum, when present, horny, ovate, narrow, composed of few whorls.

Shell spiral, ovate, convolute or involute, spire more or less elevated, surface mostly spirally punctated, aperture usually high and narrow, truncate or roundish in front, columella solid.

The genera and species referred to this family are mostly fossil. The arrangement here followed is that of Dr. Stoliczka (*Pal. Indica*, ii, 398), being a modification of the classification of Dr. F. B. Meek (*Am. Jour. Sci.*, xxxv, 89, 1863).

SUBFAMILY TORNATELLINÆ.

Shell ovate, aperture anteriorly rounded, sometimes broadly effuse, outer lip sharpened at the margin, columellar lip twisted and often plicated in front. The recent species operculated.

ACTÆONINA, d'Orb.

Syn.—Trochactæonina, Meek. Orthostoma, Desh.

Distr.—30 sp. Carboniferous to Eocene. *A. Lorientiana*, d'Orb. (lxxxviii, 46).

Shell oval, elongated, conical or fusiform, with revolving punctated striae; aperture long and narrow, widened in front, entire; lip sharp; columella thickened, but without plications.

EUCONACTÆON, Meek, 1863. (Conactæon, Meek, 1863.) Shell thin, obconic, gradually tapering anteriorly, spire either immersed or elevated, aperture very long, equally narrow all through, anteriorly rounded, columella slightly thickened, smooth. *Distr.*—Jurassic. *A. concava*, d'Orb. (lxxxviii, 47).

CYLINDRITES, Morr. and Lyc. (Goniocylindrites, Meek.) Shell subcylindrical or ovate, smooth, spire sunken or moderately elevated, aperture narrow, very high, anteriorly rounded, subeffuse, columella twisted anteriorly into a distinctly conspicuous fold. *Distr.*—Triassic and Jurassic. *A. cuspidatus*, Morris (lxxxviii, 48).

CYLINDROBULLINA, von Ammon, 1878. Shell small, with elevated, scalariform spire; columella with a slight fold. Triassic to Liassic. *A. fragilis*, Dunker.

TORNATINA, A. Ad.

Distr.—24 sp. West Indies, United States, Mediterranean, Philippines, China, Australia. On sandy bottoms, ranging to 35 fathoms.—ADAMS. Fossil, 13 sp. Tertiary. *T. coarctata*, A. Ad. (lxxxvii, 25).

Shell cylindrical or fusiform, spire conspicuous, apex sinistral, suture channeled, columella callous, 1-plaited.

Animal with a broad, trigonal head, rounded in front; tentacular lobes triangular, with eyes at their outer bases; foot short, truncated in front.

MYONIA, A. Ad., 1860.

Distr.—*M. Japonica*, A. Ad. Japan.

Shell ovate, turreted; white, thin, with slightly convex, spirally sulcated whorls; aperture oblong, a little produced anteriorly; inner lip with an oblique fold.

LEUCOTINA, A. Ad. Last whorl ventricose, minutely punctate. *M. Nipponensis*, A. Ad. Japan.

TORNATELLA, Lam.

Syn.—Actæon, Montf. (not Oken). Dactylus, Schum. Myosota, Gray.

Distr.—22 sp. United States, Britain, Senegal, Red Sea, Philippines, Japan, Peru. Fossil, numerous. Trias to Lias—; North America, Europe, South India. *T. fasciata*, Lam. (lxxxvii, 26).

Shell solid, ovate, with a conical, many-whorled spire, spirally grooved or punctate-striate; aperture long, narrow, rounded in front; outer lip sharp; columella with a strong, tortuous fold. Operculum horny, elliptical, lamellar.

Animal white; head truncated and slightly notched in front, furnished posteriorly with recumbent tentacular lobes, and small eyes near their inner bases; foot oblong, lateral lobes slightly reflected on the shell. Lingual teeth 12·12, similar, with long simple hooks.

RICTAXIS, Dall. Shell like Actæon, but with the columella projecting beyond the line of the anterior margin, forming a small tooth-like projection, or truncate obliquely. *T. punctocelata*, Cpr. (lxxxvii, 28. California.

SOLIDULA, Fischer, 1807. (? Buccinulus, Plancus. Tornatellæa, Conrad.) Shell thick, columella with two plaits. *A. solidula*, Lam. (lxxxvii, 27).

NUCLEOPSIS, Conrad. Uncharacterized. *A. subdivaricatus*, Conr. (lxxxviii, 49).

ACTÆONIDEA, Gabb. Oval, elongate; aperture narrow, outer lip simple, columella with one large transverse fold in the middle, and truncated in advance; surface ornamented by revolving ribs. *A. oryza*, Gabb (lxxxviii, 50). Tertiary; W. I. Form of Cylin-drites, sculpture of Actæon.

TRIPTYCHA, Müller, 1859.

Distr.—*T. Limnæiformis*, Müller. Cret.; Europe.

Ovate, almost perfectly smooth, aperture rounded anteriorly, outer lip sharp, inner lip with three folds, of which the middle one is largest. Only one fossil species; perhaps a Marinula.

TROCHACTÆON, Meek.

Syn.—Actæonella, d'Orb. (in part). Spiractæon, Meek.

Example.—*T. Renæauxiana*, d'Orb. (lxxxviii, 51).

Shell turbate, more or less involute, last whorl usually higher than the spire, with a flattened narrow solid edge along the suture; aperture semieffuse, anteriorly rounded, inner lip thickened, especially in front, and provided with three oblique folds.

GLOBICONCHA, d'Orb.

Distr.—6 sp. Cretaceous; France. *G. coniformis*, Römer (lxxxviii, 52). *G. Fleuriausa*, d'Orb. (lxxxviii, 53).

Shell globular-conic, spire short, or involute; aperture narrow, crescent-shaped; margin acute; columella not thickened or plaited.

TYLOSTOMA, Sharpe, 1849.

Etym.—*Tulos*, a callosity; *stoma*, mouth.

Distr.—4 sp. L. Cretaceous rocks; Portugal. *T. torrubix*, Sharpe (lxxxviii, 54).

Shell ventricose, smooth or punctate-striate, spire moderate, aperture ovate-lunate, pointed above, rounded in front; outer lip periodically (once or twice in a whorl) thickened inside and expanded, rising slightly; inner lip callous, spread over body-whorl.

Stoliczka refers this genus to Naticidæ; its true affinities are difficult to ascertain.

VARIGERA, d'Orb. Shell with lateral varices. *T. Rochatiana*, d'Orb. (lxxxviii, 55). Cret.; France.

SUBFAMILY RINGICULINÆ.

The shells resemble Actæon except that they have the margins of the aperture strongly thickened and externally varicose, the canal is twisted or plaited, and always terminates anteriorly with a distinct fold, in front of which there is a groove or kind of canal in the thickened margin. The other genera proposed may well be considered subgenera of Ringicula.

RINGICULA, Desh.

Etym.—Diminutive of *ringens*, from *ringo*, to grin.

Syn.—Aptycha, Meek.

Distr.—75 sp., the recent ones in all warm seas. Fossil. Miocene—. *R. buccinea*, Desh. (lxxxvii, 29).

Shell minute, ventricose, with a small spire; aperture notched, columella callous, deeply plaited; outer lip thickened and reflected.

RINGINELLA, d'Orb. Shell oval, with revolving punctate striæ; aperture entire, without channel; outer lip strongly thickened; inner lip thickened, with anterior plications. Several cretaceous species. *R. clementina*, d'Orb. (lxxxviii, 57).

ERIPTYCHA, Meek. (Euptycha, Meek, preoccupied). Shell globose, aperture very narrow, one strong, often bifid anterior

fold in the inner lip, which is in the middle, flattened and projecting in the space of the aperture, being separated from the fold by a deep insinuation; the outer lip is generally somewhat produced anteriorly, the anterior canal being distinct. Cretaceous. *R. decurtata*, Sowb.

? STOMATODON, Seely, 1861. Described from a cast in the Cambridge Greensand. May be a Ringicula. *R. polita*, Seely.

CINULIA, Gray.

Distr.—25 sp. Cretaceous; Europe, United States. *C. globulosa*, Desh. (lxxxviii, 58).

Shell globose, spire short, surface spirally sulcated, aperture anteriorly produced, effuse, columella terminating with a single oblique and twisted fold.

OLIGOPTYCHA, Meek. Shell with spire much depressed and obtuse; outer lip smooth within, and very slightly sinuous at the base of the aperture; inner lip bearing a single, very prominent, nearly transverse plication or tooth at the base of the columella. *Actæon concinnus*, Hall and Meek (lxxxviii, 59).

AVELLANA, d'Orb. Shell globose, inner lip with two or three folds, one being anterior, often bipartite, placed at the termination of the columella, the other subanterior, separated from the former by a deep insinuation of the lip; there is generally a third one placed about the middle of the inner lip, and one or two posterior, much shorter ones, but these are not constant. *A. incrassata*, d'Orb. (lxxxviii, 60).

FAMILY CYLICHNIDÆ.

Shell external, spiral, more or less cylindrical, usually white. No operculum. Animal with depressed quadrangular head; truncated in front; bilobed behind; with eyes at the base of tentaculiform lobes; foot rather narrow, truncated in front. Teeth, central none, laterals 6·6, the inner large and hooked, the outer small and uniform, rarely wanting.

CYLICHNA, Lovén.

Syn.—Bullina, Risso.

Distr.—40 sp. Chiefly deep-water shells. United States, Greenland, Britain, Red Sea, Australia. Fossil. Triassic—. *C. arachis*, Quoy (lxxxvii, 30).

Shell strong, cylindrical, smooth or punctate-striate; spire minute or truncated; aperture narrow, rounded in front; columella callous, with one plait.

MNESTIA, H. and A. Adams. Shell oval, subcylindrical, banded, with revolving striæ; aperture narrow, prolonged into a point at both ends. *C. marmorata*, A. Ad. (lxxxvii, 31).

CYLICHNELLA, Gabb. Shell subcylindrical, spire sunken; mouth

narrow behind, widened in front; columella with two folds. *C. bidentatus*, d'Orb. (lxxxvii, 33). Tertiary; West Indies.

VOLVULA, A. Adams. Shell subcylindrical, attenuated to a point posteriorly, to which the narrow aperture extends; spire concealed; outer lip sharp; columella with an obsolete anterior plication. *C. acuminata*, Brug. (lxxxvii, 34).

ACTEONELLA, d'Orb. (Volulina, Stoliez.) Shell convolute, like *Volvula*, attenuated at both ends, aperture linear, inner lip anteriorly thickened and provided with three folds. The shells, which are as yet only known from cretaceous deposits, mostly closely resemble the recent *Volvula*, differing from it merely by the presence of three columellar folds on the anterior portion of the inner lip. *C. crassa*, d'Orb. (lxxxviii, 61). Cretaceous.

UTRICULUS, Brown.

Distr.—Northern. Several sp. *U. Cecillei*, Phil. (lxxxvii, 32).

Shell subcylindrical, with short spire, and thin epidermis; aperture narrow behind, wider in front; columella not plicated; outer lip thin.

Utriculus is regarded as a distinct genus by Jeffreys, differing from *Cylichna* by the tentacles being separate, the eyes distinct, the gizzard horny, and the shell having a visible spire with a mammillary apex.

DIAPHANA, Brown.

Syn.—*Amphisphyra*, Löven.

Distr.—A few sp. Northern, U. S., Europe. *D. debilis*, Gould (lxxxvii, 35).

Shell thin, transparent, oval-globular; spire very short; aperture much widened anteriorly; columella a little sinuous; outer lip thin, sinuous, broadly rounded anteriorly.

Head-disk broad and short; tentacular lobes short, conical, lateral, wide apart; eyes immersed in their hind bases. Mantle-margin slightly thickened. Foot short, bilobed behind.

In this genus, as in *Rissoella*, Gray, the eyes are placed far back behind the head, so that in order to render the vision of the animal distinct, the shell is nearly transparent. The head of the animal is very short, and the tentacles wide and far apart.

FAMILY BULLIDÆ.

Shell spiral, ventricose, rather thick; maculated and banded in the typical genus, white in others; spire involute; external, but usually partly covered by the lateral lobes of the foot.

BULLA, Linn.

Distr.—50 sp. Universal. *B. ampulla*, Linn. (lxxxvii, 36). Fossil. Cretaceous—

Shell oval-globular, smooth, spotted, marbled or zoned; spire

concave, umbilicated; aperture as long as the shell; inner margin without columella; outer lip trenchant.

Teeth, central one, laterals numerous, uniform, in an arched series. Animal partly investing, but not entirely covering the shell. Eyes conspicuous, sessile on the middle of the frontal disk. Mantle with the outer margin forming a thick, fleshy lobe. Foot with the lateral lobes moderate, and the hind-part not extending beyond the shell. The species of this genus inhabit sandy mud-flats, the slimy banks of river-mouths, and brackish places near the sea; at low-water some of them conceal themselves in the mud and under sea-weed, exuding large quantities of mucus to maintain the moisture of their skin; they feed on bivalves and other mollusca, which they swallow whole, reducing and crushing them afterwards by the calcareous plates of their powerful gizzard. The shells of *Bulla*, as restricted, are rather solid, smooth, and mottled and marbled like birds' eggs.

HAMINEA, Leach.

Example.—*H. hydati*s, Linn. (lxxxvii, 37, 38).

Shell oval-globular, spiral, ventricose, corneous, thin, covered by a slight, smooth epidermis; spire involute. May be distinguished from *Bulla* immediately by the want of color in the shell.

ATYS, Montfort.

Example.—*A. naucum*, Linn. (lxxxvii, 39).

Shell rather solid, uncolored, with a smooth epidermis; usually spirally striated; spire scarcely visible; aperture longer than the inner margin at both ends; columella with a single, more or less obsolete plication.

The animal is blind, or the eyes are subcutaneous.

LAONA, A. Ad. Semiovate, thin, striæ of growth lamellar, spire hidden; aperture with the inner lip arcuated, outer lip simple. *A. zonata*, A. Ad. Japan.

DINIA, H. and A. Adams. Shell ovoid, subtruncated behind, longitudinally striated; inner lip truncated anteriorly, terminating in a tooth-like projection. *A. dentifera*, Ad. (lxxxvii, 40).

SAO, H. and A. Adams. Shell pyriform, ventricose in front; umbilicated; apex involute; aperture narrow behind, wide in front; columellar lip reflected; outer lip thin, sinuous. *A. pyriformis* (lxxxvii, 41).

PHYSEMA, H. and A. Adams. Shell small, thin, hyaline, globular; umbilicated; very finely longitudinally striated; columella a little arcuated, reflected; outer lip thin, free behind, developed in the middle. *A. hiemalis*, Couth. (lxxxvii, 42).

ROXANIA, Leach. Shell ovoid, solid, perforate, decussately striate, transversely profoundly sulcate, the sulcations strongly punctate; aperture narrow, dilated in front; inner lip sharp,

truncate anteriorly; outer lip produced behind. *A. Cranchii*, Leach.

ALICULA, Ehrenberg, 1831. Shell subcylindrical, transversely striate. 3 sp. Japan. *A. translucens*, A. Ad. Japan.

LEUCONYX, H. and A. Ad., a supposed new genus of Bullidæ, is the spatulate hinge process of *Pholas costata*.

FAMILY APLUSTRIDÆ.

Teeth, central none; laterals numerous, uniform. Head with the frontal disk produced into large ear-like tentacular lobes folded over the back of the shell, and furnished with bifid labial appendages; eyes sessile at the inner bases of the tentacular lobes. Mantle with the inner margin thin and membranous, the outer forming a thick, fleshy lobe, curving round the spire of the shell; branchial plume long and single. Foot large and membranous, auriculate in front, rounded behind.

The shell has usually a short spire, the last whorl inflated, aperture anteriorly distinctly effuse, columella somewhat thickened, rarely twisted, but always anteriorly truncated.

APLUSTRUM, Schumacher.

Etym.—*Aplustre*, a ship's flag.

Distr.—1 sp. Coral reefs, East Indies. *A. aplustre*, Linn. (lxxxvii, 43).

Shell oval, ventricose, highly colored; spire wide, depressed; aperture truncated in front; outer lip sharp.

Differs from *Bullina* by its smooth, somewhat thinner shell, more depressed spire, the columella being very thick, slightly twisted and truncated in front.

BULLINA, Fer.

Distr.—*B. lineata*, Wood (lxxxvii, 44).

Shell oval, rather solid, subumbilicated; spire distinct; whorls with revolving striæ; columella arcuated, obliquely truncated in front; outer lip crenelated.

KLEINELLA, A. Ad., 1860. Shell ovate, thin, umbilicated, cancellated, aperture produced anteriorly, inner lip not plicated. Resembles *Actæon*, but without columellar fold. Japan. *B. cancellaris*, A. Ad.

HYDATINA, Schum., 1817.

Distr.—Recent, several sp. Fossil. Jurassic—. *H. physis*, Linn. (lxxxvii, 45).

Shell ventricose, thin, smooth, not umbilicated, with a thin epidermis; usually banded; spire involute; columella arcuated, reflected.

BULLOPSIS, Conr. Like Hydatina with a depressed spire and inflated body-whorl, inner lip with two close folds. *B. cretacea*, Conr. Cretaceous; Mississippi.

ETALLONIA, Deshayes, 1864.

Etym.—Dedicated to M. Etallon, a French palæontologist.

Distr.—3 sp. Eocene; Paris basin, Valognes. *E. prisca*, Desh. (lxxxviii, 62).

Shell ovate, subfusiform, resembling certain small Mitres; spire short, conical, obtuse, few-whorled; aperture elongated, narrow, base entire, subemarginate; lip simple, acute, arched; columella thick, cylindrical, twisted in the middle to resemble an obtuse plait; acute anteriorly.

FAMILY LOPHOCERCIDÆ.

Shell spiral, very thin, subflexible, with epidermis.

Head with two ear-like tentacles; eyes sessile on the sides of the head; gill regular, pectinate; organs of generation close together in one tubercle; male organ on the right side of the nape near the tentacle. In *Lophocercus*, the body is covered with papillæ, and produced behind into a long, pointed tail; foot with the natatory appendages undivided, reflexed and partly covering the shell in front and united posteriorly.

LOPHOCERCUS, Krohn.

Syn.—*Icarus*, Forbes. *Oxynoë*, Raf.

Example.—*L. Sieboldi*, Krohn (lxxxix, 68, 70).

Shell like *Bullæa*; convoluted, thin, ovate, covered with epidermis, outer lip separated at the suture, posterior angle inflected and rounded.

Animal slender, papillose; tentacles 2, ear-shaped; eyes sessile on sides of head; side-lobes reflected and partly covering the shell, united behind; tail long and pointed.

VOLVATELLA, Pease. Shell resembling *Lophocercus*, but more convolute. Foot small, mantle concealed, vent posterior, eyes concealed in the fold of the sides of the head. *L. fragilis*, Pease.

AKERA, Müller.

Etym.—*Akeros*, hornless.

Distr.—7 sp. Greenland, Great Britain, Mediterranean, East Indies, New Zealand. *A. soluta*, Chemn. (lxxxix, 63). Fossil. Eocene.

Shell thin, flexible, globosely cylindrical, spire truncated, whorls channelled; aperture long, expanded and deeply sinuated in front, outer margin disunited at the suture; columella open, exposing the whorls.

Head-disk greatly elongated, wide and bifid anteriorly, and

narrowed posteriorly; the hind edge of the mantle is fimbriated and projects through the fissured suture of the shell; foot expanded, narrow and rounded anteriorly, broad and truncated posteriorly; by means of the extended lateral foot-lobes the animal swims with considerable facility.

CYLINDROBULLA, Fischer. Shell cylindrical, bulliform, thin, fragile, spire very short, suture slit; outer lip incurved, closing the aperture in the middle. *A. Beauvi*, Fischer (lxxxix, 63).

LOBIGER, Krohn.

Distr.—4 sp. Atlantic, South Europe. *L. Philippii*, Krohn (lxxxix, 65, 66).

Shell oval, transparent, flexible, slightly convoluted; covered with epidermis.

Animal slender, papillose, with two flattened, oval tentacles, and minute sessile eyes on the sides of the head; shell exposed on the middle of the back, covering the plume-like gill; sides with two pairs of rounded, dilated lobes, or natatory appendages, foot linear, tail long and slender.

The four laterally expanded wing-like lobes easily distinguish this animal from *Lophocercus*.

FAMILY APLYSIIDÆ.

Shell wanting, or rudimentary and covered by the mantle, oblong, trigonal, or slightly convoluted.

Animal slug-like, with distinct head, tentacles, and eyes; foot long, drawn out into a tail behind; sides with extensive lobes, reflected over the back and shell; branchial plume concealed. Sexes united.

APLYSIA, Gmelin.

Etym.—*Aplysia* (from *a* and *pluo*), unwashable; the *Aplysia* of the Greek fisherman were sponges unfit for washing. Seahare. *Syn.*—*Siphonotus* (*geographicus*), Ad.

Distr.—48 sp. West Indies, Norway, Britain, Mediterranean, Mauritius, China. Fossil (?). Tertiary; Sicily. *A. depilans*, Linn. (lxxxix, 67, 71).

Shell oblong, convex, flexible, and translucent, with a posterior slightly incurved apex.

Animal oval, with a long neck and prominent back; head with four tentacles, dorsal pair ear-like with eyes at anterior lateral bases; mouth proboscoidiform, with horny jaws, lingual teeth 13·1·13, hooked and serrated, about 30 rows; gizzard armed with horny spines; sides with ample lobes folding over the back, and capable of being used for swimming; gill in the middle of the back, covered by the shell and by a lobe of the mantle, which is folded posteriorly to form an excretory siphon.

The Sea-hares are mixed feeders, living chiefly on sea-weed, but also devouring animal substances; they inhabit the laminarian zone, and oviposit amongst the weed in spring, at which time they are frequently gregarious.—FORBES. They are perfectly harmless animals, and may be handled with impunity. When molested they discharge a violet fluid from the edge of the internal surface of the mantle, which does not injure the skin, has but a faint smell, and changes to wine-red.

“Wonderful tales used to be told of the more than poisonous qualities of the *Aplysia*. Pliny, Ælian, and especially Aldrovandi, collected all these absurd notions. One was that if the animal were touched, even with a walking-stick, the danger would be not less than from the look of a basilisk; another was that it caused baldness; and a third that pregnant women miscarried at the sight of this horrid creature. Cuvier has satisfactorily shown that *Aplysia* is quite harmless, and that it did not deserve the bad character given to it by the ancients; he says truly that fishermen have always had a fancy to attribute mischievous properties to those marine animals which are of no use as the food of man. I would remark, however, by way of parenthesis, that the *Aplysia* is not quite inoffensive, as any one may be convinced by handling it; the smell is insufferably nauseous. This and its slabby appearance are certainly enough to take away the appetite of any civilized being. But Mr. Lesson states that one kind is eaten raw and esteemed a delicacy by the natives of the Society or Friendly Isles. The *Aplysiæ* secrete occasionally a whitish slime. Spawn-case gelatinous, of a pinkish hue, thread-like, and irregularly convoluted; ova white and very numerous, lying in the middle. The embryonic shell is globular; it becomes the apex in after-growth, being persistent, as in *Teredo*.”—JEFFREYS, *Brit. Conch.*

PHYLLAPLYSIA, Fischer.

Distr.—3 sp. Europe. *P. ornata*, Desh. (lxxxix, 69).

Body flat, neck short, foot broad, natatory lobes small. Shell absent or horny (?). Teeth of radula trienspid, blunt. Copulation reciprocal, as in *Helix*, not in multiple chains, as in true *Aplysia*.

APLYSIELLA, Fischer.

Distr.—2 sp. Europe. *A. petallifera*, Rang (lxxxix, 72).

Aplysia, with the natatory lobes rudimentary as in *Dolabella*, the shell very thin.

DOLABRIFERA, Grube.

Distr.—4 sp. Indian Ocean, West America. *D. Cuvieri*, Ads. (lxxxix, 73).

Shell trapezoidal; side-lobes not used for swimming.

DOLABELLA, Lamarck.

Etym.—*Dolabella*, a small hatchet.

Distr.—12 sp. Mediterranean, Mauritius, Ceylon, Society Islands, Sandwich Islands. *D. Teremidi* (lxxxix, 74, 75).

Shell hard, calcareous, trigonal, with a curved and callous apex.

Animal like *Aplysia*, with gill near posterior extremity of the body and lateral crests closely appressed, leaving only a narrow opening; ornamented with branching filaments.

SIPHONOPYGE, Brown.

Distr.—6 sp. West America, Chinese Sea. *S. lurida*, d'Orb. (lxxxix, 76, 77).

Shell truncated in front; foot-lobes spread out for swimming; posterior part extended beyond the siphon.

NOTARCHUS, Cuvier.

Etym.—*Notos*, the back, *archos*, vent.

Syn.—*Busiris* (*griseus*), Risso.

Distr.—7 sp. Mediterranean, Red Sea, living in floating masses of sea-weed. *N. ocellatus*, Rang (lxxxix, 78).

Animal ornamented with filaments, sometimes dendritic, foot narrow, lateral crests united, leaving only a narrow branchial slit; gills not covered by an opercular mantle-lobe.

Notarchus was long supposed to be without a shell; it is present, however, paucispiral, only a millimetre in diameter, and concealed under the mantle at the posterior part of the visceral mass.

ACLESIA, Rang.

Distr.—Several sp. East Indies. *A. rufa*, Quoy (lxxxix, 79).

Animal elongated, with a pointed posterior termination covered with filiform appendages; four long tentacles; gills in a branchial cavity. No shell.

BURSATELLA, Blainville.

Distr.—*B. Leachii*, (lxxxix, 80).

Subglobular, the natatory appendages united together on the back, leaving a dorsal cavity containing the anus and a large free gill; four ramified tentacles, and two buccal appendages. No shell. Is possibly identical with *Aclesia*, the globular shape being due, perhaps, to immersion in alcohol.

STYLOCHEILUS, Gould, 1841.

Distr.—3 sp. New Guinea, on Fuci. *S. longicauda*, Quoy (lxxxix, 81).

Animal limaciform; cirriferous, dilated at the sides, attenuated behind; neck distinct; tentacles four, long, linear, papillose, far apart; lips dilated laterally into tentacular processes.

FAMILY PLEUROBRANCHIDÆ.

Shell limpet-like or concealed, rarely wanting; mantle or shell covering the back of the animal; gill lateral, between the mantle-margin and foot; food vegetable, stomach extremely complicated.

The animals of this family have no upper jaw, the lingual membrane is armed with numerous short teeth, arranged in a quincunx; there are four stomachs, the second of which is fleshy, and sometimes furnished with bony pieces, and the third is provided internally with prominent longitudinal lamellæ; the intestinal canal is short. The species are tolerably numerous, occasionally of large size and adorned with varied colors; they are mostly inhabitants of the high seas.

PLEUROBRANCHUS, Cuvier.

Etym.—*Pleura*, side, *branchia*, gill.

Syn.—*Berthella*, Bl. *Oscanus*, Gray. *Haliotinella*, Souverb.

Distr.—22 sp. South America, Norway, Britain, Mediterranean, Red Sea, Ceylon. *P. citrinus*, Rüppell (lxxxix, 82, 83).

Shell internal, large, oblong, flexible, slightly convex, lamellar, with a posterior, subspiral nucleus.

Animal oblong, convex; mantle covering the back and sides, papillated, containing spicula; foot large, separated from the mantle by a groove; gill single, free at the end, placed on the right side between the mantle and foot; orifices near the base of the gill; head with two grooved tentacles, eyes at their outer bases; mouth armed with horny jaws and covered by a broad veil with tentacular lobes.

PLEUROBRANCHÆA, Meckel. (Pleurobranchidium, Blainv.)

Mantle-margin very narrow, not concealing the gill; dorsal tentacles ear-like, oral veil tentaculiform. *P. Meckelii*, Blainv. (lxxxix, 90).

KOONSIA, Verrill, 1882. (Dedicated to B. F. Koons, U. S. Fish Commission.) Allied to Pleurobranchæa, with which it agrees in the character of the head, tentacles, proboscis and gill. It differs in having the back swollen and overhanging both on the sides and posteriorly, and a distinct mantle-edge all around, with a wide groove between it and the foot posteriorly, as well as laterally; the foot is narrower and prolonged posteriorly, with a specialized glandular area, near the end, beneath, and a conical papilla above near the tip. The external reproductive organs appear less complicated than in Pleurobranchæa. The verge is armed with small hooks, but the spicule, present in the latter genus, is not protruded, if present, in the specimens of *Koonsia*; urinal opening at the anterior root of the gill; between this and the verge, some specimens show a small opening and a low papilla, but none show the large opening and long flat papilla

of Pleurobranchæa; anal opening behind the base of the gill; gill large, bipinnate, fully exposed on the right side, between the mantle and the foot. *Distr.*—*K. obesa*, Verrill. Atlantic Coast, United States.

POSTEROBRANCHÆA, d'Orbigny.

Distr.—*P. maculata*, d'Orbigny (lxxxix, 91). Coast of Chili.

Animal shell-less; oval, depressed, covered by a mantle broader than the foot; foot oblong, bilobed behind; branchial plume on the left side, projecting posteriorly; reproductive orifice in front of gill, excretory behind; proboscis covered by a broad bilobed veil; no dorsal tentacles.

RUNCINA (Forbes), Hancock.

Syn.—? *Pelta*, Quarr. (not Beck).

Distr.—On *Confervæ* near high-water mark, Torbay; feeds apparently on *Diatomaceæ*. *R. Hancocki*, Forbes (lxxxix, 84; xci, 44).

Animal minute, slug-like, with a distinct mantle; eyes sessile on the front part of the mantle; no tentacles; gills three, slightly plumose, placed with the vent on the right side, at the hinder part of the back, beneath the mantle; gizzard armed; reproductive organs on the right side. Dentition (xiii, 70).

NEDA, H. and A. Adams.

Distr.—*N. luniceps*, Cuv. (lxxxix, 85). South Europe.

Animal shell-less; mouth terminating a proboscis, which is long and thin; oral veil half-moon shaped, with two lateral recurved tentacles.

SUSANIA, Gray.

Distr.—*S. testudinaria*, Phil. (lxxxix, 86).

Mantle very large, broadly margining the foot, vesicular, deeply notched in front; frontal veil between the base of the tentacles and mouth large and oblong; foot oblong, rather narrow. Shell very small.

FAMILY UMBRELLIDÆ.

Shell depressed patelliform, thin, calcareous.

Tentacles dorsal, ear-like, with plicate cavities at their bases; mouth probosciform, retractile, covered by a small oral veil with moderate labial appendages, and concealed in the notch at the fore-part of the foot. Foot large and thick, deeply fissured in front, the sides tubercular.

UMBRELLA, Lam.

Chinese umbrella-shell.

Syn.—*Operculatum*, Linn. (part). *Acardo*, Lam. *Gastroplax*, Bl.

Distr.—6 sp. Canaries, Mediterranean, India, China, Sandwich Islands. Fossil, 4 sp. Jurassic—; United States, Sicily, Asia. *U. Mediterranea*, Lam. (lxxxix, 87). *U. Indica*, Lam. (lxxxix, 88).

Shell limpet-like, orbicular, depressed, marked by concentric lines of growth; apex subcentral, oblique, scarcely raised; margins acute; inner surface with a central colored and striated disk, surrounded by a continuous irregular muscular impression. It has a minute sinistral nucleus.

TYLÖDINA, Rafinesque.

Distr.—3 sp. Mediterranean, Norway. Fossil, 1 sp. Tertiary. *T. punctulata*, Raf. (lxxxix, 89).

Shell limpet-like, depressed, apex subcentral, with a minute spiral nucleus.

Animal oblong, foot truncated in front, rather pointed behind; dorsal tentacles ear-like, with eyes sessile at their inner bases; oral tentacles broad; branchial plume projecting posteriorly on the right side.

ORDER NUDIBRANCHIATA.

Animal destitute of a shell except in the embryo state; branchiæ always external, on the back or sides of the body. Sexes united.

The Nudibranchiate sea-slugs are found on all coasts where the bottom is firm or rocky, from between tide-marks to a depth of fifty fathoms; a few species are pelagic, crawling on the stems and fronds of floating sea-weed. They have been found in the Icy Sea, at Sitka, and in the sea of Ochotsk; in the tropical and southern seas they are abundant. They require to be watched and drawn whilst living and active, since after immersion in spirits they lose both their form and color. In some the back is covered with a mantle (viii, 39), which contains calcareous spicula of various forms, sometimes so abundant as to form a hard shield-like crust. The dorsal tentacles and gills pass through holes in the mantle somewhat like the "key-hole" in *Fissurella*. In others there is no trace of a mantle whatever. The eyes appear as minute black dots, immersed in the skin, behind the tentacles; they are well organized and conspicuous in the young, but often invisible in the adult. The dorsal tentacles are laminated, like the antennæ of many insects; they are never used as organs of touch, and are supplied with nerves from the olfactory ganglia. The Dorididæ are distinguished by having a short and wide lingual membrane with numerous similar teeth; the Æolidæ have a narrow ribbon with a single series of larger teeth. In *Dendronotus* a large central tooth is flanked by a few small denticulated teeth.

The only Nudibranch with a solid upper jaw, is *Ægirius punctilucens*. In other instances the two halves are articulated and act as lateral jaws. In *Ægirius* the mouth is also furnished with membranous fringes. *Ancula cristata* has a formidable spinous collar. The skin acts as an accessory breathing-organ; it performs the function entirely in the Elysiadæ, and in the other families, when by accident the branchiæ are destroyed. The water on the gills is renewed by ciliary action. The fry is provided with a transparent, nautiloid shell, closed by an operculum, and swims with a lobed head-veil fringed with cilia, like the young of most other gastropods.

"While the numerous tribes of Mollusks furnished with testaceous coverings offer us objects of contemplation remarkable alike for their extreme beauty and the durability of their calcareous envelopes, the scarcely less extensive and certainly far less known families of naked-gilled gastropods exhibit an astonishing variety of form, extreme delicacy of organization, and great diversity of color to captivate the eye and occupy the attention of those who wander by the shore or explore the depths of the ocean. Clinging to the stems of floating seaweeds, many, like the Anthobranchs, will be seen extruding their flower-like gills of surpassing elegance, exploring with their foliated tentacles or complex mantle-filaments the plants around them, the brilliant hues of their striped or spotted bodies glancing through the water; some will be observed with bodies so fragile and pellucid that you may see the color of their blood and count the pulsations of their hearts; some will be seen to have their gills disposed in rows of papillary tubercles on the sides of their bodies, like the *Æolids*, or tree-like and branching, like the *Tritonias*; the foreheads of some will be smooth and simple, while those of others will be found adorned with various singular appendages; in others, again, all processes will disappear, all branchial arrangements vanish, and we shall meet with forms almost as simple in their appearance as the Nemertoid types among the Annelids."—H. and A. ADAMS.

SUBORDER ANTHOBRANCHIATA.

The branchiæ more or less surrounding the anus upon the medio-dorsal line.

FAMILY DORIDIDÆ.

Mantle (nothæum) large, without marginal appendages; skin generally very spiculose; dorsal tentacles (rhinophora) laminate and retractile within cavities. Dentition (xiii, 69).

DORIS, Linn.

Syn.—Argus, Bohadsch. Archidoris, Bergh.

Distr.—157 sp. Universal. *D. Johnstoni*, Alder and Hancock (xc, 92).

Body depressed, or subconvex; integument spiculose; mantle often tuberculate, covering the head and the foot; branchiæ plumose or ramose, united at the base, and retractile with the anus into a common pallial cavity; mouth inferior, with two distinct oral tentacles (rarely absent); odontophore broad, with numerous spines in each transverse row. Bergh has proposed the name ARCHIDORIS for the thus restricted typical group.

ANGASIELLA, Crosse, 1864.

Distr.—*A. Edwardsi*, Angas. Australia.

Body elongate, rounded in front, attenuated and produced into a point behind; mantle everywhere covering the head and foot; dorsal tentacles 2; subclavate; branchiæ plumose, few, and placed before the anus, a little behind the middle of the back.

As M. Crosse has told us nothing about the retractility of the branchiæ or the condition of the oral tentacles, odontophore, etc., we cannot be certain of the position of this group.

KENTRODORIS, Bergh, 1876.

Distr.—3 sp. Australasia. *K. rubescens*, Bergh.

Mantle broad, soft, with the upper side everywhere minutely granular; rhinophores retractile; tentacles conical; branchiæ retractile, the plumes tripinnate, podarium broad, the margin in front deeply grooved, with the upper lip veliform and deeply emarginated; rounded behind; no buccal armature; no median tooth, the lateral ones uncinatæ. Penis armed with a spine.—BERGH.

CHROMODORIS, Ald. and Hanc., 1855.

Syn.—Doriprismatica, d'Orb, 1837 (part). Goniodoris, Gray, 1850 (part). Goniobranchus, Pease, 1866. Hemidoris, Stimpson, 1855.

Distr.—97 sp. Medit., Red Sea, Indian Ocean and Australasia. *C. magnifica*, Quoy (xc, 93).

Body elongate, subquadrate; mantle narrow, covering the head but not the extremities of the foot; generally smooth and marked with bright colors in stripes or spots; oral tentacles conical or tubercular. Branchiæ linear, usually pinnate, retractile in a common cavity. Odontophore broad, with numerous transverse rows of many close-set plates, each bearing two large spines, one in front of the other, the posterior one bearing denticulations, no central plate; a buccal collar, formed of two broad plates, bearing close minute bifid spines.

APHELodoris, Bergh. Somewhat like Chromodoris, but mantle and foot narrow; tentacles truncate, canaliculate; gills retractile, consisting of five tripinnate leaves; labial disk unarmed. Radula without median plate, lateral plates with many hooked teeth. *A. Antillensis*, Bergh. St. Thomas, W. I.

HOMIODORIS, Bergh, 1881.

Distr.—*H. Japonica*, Bergh. Japan.

Form of the body as well as the rhinophores, tentacles and branchia as in *Archidoris*; prostate large; vagina armed.

PETEODORIS, Bergh, 1881.

Distr.—*P. triphylla*, Bergh. Japan.

Body subdepressed, the back minutely hirsutely tuberculated; branchial aperture valved; branchial leaves tripinnate; tentacles short, triangular; penis unarmed.

ORODORIS, Bergh, 1875.

Distr.—*O. miamirana*, Bergh. Tahiti.

Mantle (nothæum) somewhat as in *Miamira*. Keeled above with transverse ribs; no frontal or caudal veils, or lateral lobes lamellate beneath. Foot rather narrow. Integument without spicules. Armature of the oral aperture as in *Miamira*—a spinous buccal collar. Odontophore as in *Miamira*; but the rachis is hardened.—BERGH.

CERATODORIS, Gray.

Syn.—*Echinodoris*, Bergh, 1874.

Distr.—*C. solida*, Quoy (xc, 1). Waigiou.

Form rather depressed; back everywhere covered with elongated papillæ; back and papillæ spiculose. Rhinophores and branchiæ retractile. Odontophore with the pleuræ multidentate. Penis armed at the apex with a series of minute uncini.—BERGH.

HEXABRANCHUS, Ehrh., 1831.

Syn.—*Heptabranhus*, Adams. *Rhacodoris*, Mörch (part).

Distr.—18 sp. Red Sea, Indian O., and Australasia. *H. sanguineus*, Rüppell (xc, 94).

Body soft; integument non-spiculose (?); rhinophores sharply bent, and with an anterior knee, retractile within marginated cavities; branchiæ generally small, numerous, ramose, non-retractile, arranged in six or eight tufts, which are set in an open circle at some distance around the anal opening; oral tentacles large, fleshy, flat, ovoid or leaf-shaped, with crenulated edge. Odontophore broad, with numerous lateral simple spines in each transverse row; none median in position.

CALYCIDORIS, Abraham, 1876.

Distr.—*C. Güntheri*, Abr. Hab.—

Body depressed; mantle ample, covered with soft papillæ; branchiæ simply laminate, arranged like a cup around the anus, subretractile in a common cavity. Oral tentacles represented by a fleshy, laterally extended veil. Odontophore narrow, bearing

two bicuspid spines, one each side, in each transverse row; no central spine, spinous collar, or under jaw.

LAMELLIDORIS, Ald. and Hanc., 1855.

Syn.—Onchidoris, De Blainv., 1816. Onchidorus, Ferussac, 1821. Onchidora, Cuv., 1830. Villiersia, d'Orb., 1837. Oncidiodoris, Agassiz, 1847. Oncodoris, Agassiz, 1847.

Distr.—23 sp. E. Coast of N. Am., W. Coast of Europe, and New Zealand. *L. Leachii*, Blainv. (xc, 95). *L. scutigera*, d'Orb. (xc, 96).

Body depressed; mantle large; head with a veil in place of oral tentacles; branchiæ simply pinnate, set in an open circle or ellipse, non-retractile. Odontophore narrow, with a few spines in each transverse row.

ACIODORIS, Bergh, 1879. General form like Lamellidoris, but suctorial proventricle simple, and 12–13 lateral teeth on the radula; male organ armed with simple or forked hooks. *L. lutescens*, Bergh. N. Pacific.

ADALARIA, Bergh, 1879. Like Lamellidoris, but radula with small flat (spurious) median plates and a large hook-shaped lateral tooth. *A. Pacifica*, Bergh.

ACANTHODORIS, Gray, 1850.

Distr.—4 sp. Universal. *A. pilosa*, Müll. (xc, 97).

Body convex; mantle moderate in size, covered with soft papillæ; oral tentacles united in a veil, with free flattened lateral ends; branchiæ united at the base, non-retractile. Odontophore narrow, with two large spines and several rudimentary ones in each transverse row; none central, usually a spinous buccal collar and rudimentary under jaw.

DICTYODORIS, Bergh, 1881.

Distr.—*D. tessellata*, Bergh. Pelew Islands.

Body depressed, coriaceous, smooth above; branchial aperture rounded, with few compound gill-leaves; tentacles finger-shaped; foot in front scarcely bilabiate. Radula without median plate, and with many-toothed pleuræ, the teeth hook-like, the external pectinate at the tip. No peculiar armature in the lips or penis.

DIAULULA, Bergh, 1879.

Distr.—*D. Sandiegensis*, Cooper.

Back minutely shaggy; tentacles finger-shaped; gill-leaves tripinnate; radula without median plates.

ARTACHÆA, Bergh, 1881.

Distr.—*A. rubida*, Bergh. Philippines.

Body depressed, verruculose above; tentacles finger-like; branchial leaves tripinnate; foot rounded in front; penis armed with hooks.

CADLINA, Bergh, 1879.

Distr.—3 sp. N. Atlantic, N. Pacific. *C. repanda*, Ald. and Hanc.

Back granulated, gill formed by a few tripinnate leaves; tentacles flattened, triangular; lips armed by minute hooklets; radula with a median-toothed plate, many-toothed lateral plates; male organ armed with hooklets.

JORUNNA, Bergh, 1879.

Distr.—N. Pacific Ocean. *J. Johnstoni*, Ald. and Hanc.

Back minutely granulated; gill-leaves tripinnate; tentacles finger-shaped; radula without median plate; lateral plates many-toothed; male organ armed with a sting.

ALDISA, Bergh.

Example.—*A. Zetlandica*, Ald. and Hanc.

Back almost shaggy, soft; gills composed of six tripinnate leaves; tentacles wart-shaped. Radula without median plate, lateral plates many-toothed, teeth erect, staff-like, denticulate externally.

ROSTANGA, Bergh.

Example.—*Doris coccinea*, Forbes.

Back minutely granulate, gills composed of sixteen bipinnate leaves; tentacles finger-shaped. Radula without median plate, lateral plates many-toothed, teeth bifid at the tips.

DISCODORIS, Bergh.

Distr.—*D. Boholensis*, Bergh. Philippines.

Body depressed, rounded or oval, granulate above; branchial aperture slightly crenulate or bilabiate; anterior margin of the foot bilabiate, the upper lip fissured; labial laminae forming minute hooks.

HOPIODORIS, Bergh, 1881.

Distr.—*H. desmoparypha*, Bergh. Pelew Islands.

Armature of the lips consisting of very small rods; penis armed with several series of conical prominences; a horn-shaped dart and a dart-gland present; in other respects like Discodoris.

ASTERONOTUS, Ehrenberg.

Distr.—5 sp. *A. Hemprichii*, Ehrenb.

Body depressed, coriaceous; smooth above, frequently nodose, with a median carina; branchial aperture stellate; foot bilabiate in front, the upper lip profoundly fissured; labial armature none.

SPHÆRODORIS, Bergh.

Syn.—*Actinocyclus*, Ehrenb.

Distr.—2 sp. Philippines. *S. grandiflora*, Rapp (xc, 98).

Body ovate or rounded, cancellate above and set with tubercles; tentacles none; branchiæ simply lamellate; anal aperture nearly central; foot wide, anterior margin strongly emarginate; labial armature of small hooks.

DORIDUNCULUS, Sars.

Distr.—*D. echinulatus*, Sars. Norway, etc.

Mantle short, broad, with elongate spicula; two longitudinal ridges on its back; gills not retractile.

PLATYDORIS, Bergh.

Distr.—16 sp. West Indies, Philippines, Mediterranean. *P. argo*, Linn.

Body flattened, coriaceous, rigid, minutely granulated on the back; branchial opening stellate; anterior margin of foot bilabiate, superior lip profoundly cut; no labial armature. Dentition: no rachidian teeth, pleuræ multidentate, teeth hamate.

PELTODORIS, Bergh.

Distr.—*P. atromaculata*, Bergh. Naples.

Body subdepressed, oval, rather rigid, minutely granulate above; tentacles finger-like; branchial aperture rounded; branchiæ paucifoliate, tripinnate; labial armature none.

CREPIDODORIS, Pagenstecher.

Example.—*C. plumbea*, Pagenst.

Gills twenty-two, most of them arranged in the figure of a horseshoe, a few at the end placed more inwards.

THORDISA, Bergh.

Example.—*T. maculigera*, Bergh.

Form of body and radula nearly as in Discodoris; back almost villous; no labial armature.

TRIPPA, Bergh.

Example.—*T. ornata*, Bergh.

Form of the body depressed, smooth, tuberculate above and the tubercles villous; tentacles small; foot wide; no labial armature.

HALGERDA, Bergh.

Example.—*H. formosa*, Bergh.

Body subdepressed, subridged, smooth above; branchial aperture ovate; branchiæ sparsely tripinnate; tentacles none; foot narrow; no labial armature.

ATAGEMA, Grube.

Distr.—*A. carinata*, Quoy (xc, 99). New Zealand.

Mantle with longitudinal ridge on the back; tentacles clavate, retractile; gills very small.

FAMILY DORIDOPSISÆ.

Doris-like Mollusca, without well-developed spicula in the integument, with mouth suctorial, opening on the front margin of the foot, with a retractile proboscis, but destitute of odontophore, jaws, or spinous collar.

The absence of an odontophore, so generally possessed by the cephaloporous Mollusca, justified Messrs. Alder and Hancock in raising this group to the rank of a family.

DORIDOPSIS, Ald. and Hanc., 1864.

Syn.—Doriopsis, Pease, 1860. Rhacodoris, Mörch, 1863 (part). Haustellodoris, Pease, 1871.

Distr.—72 sp. Universal. *D. viridis*, Pease (xc, 100).

Body more or less depressed, ovate or elliptical. Mantle ample, covering the head and foot, smooth or with soft tubercles and without marginal appendages. Rhinophores laminated and retractile within cavities. Head indistinct, generally with two small lateral lobes, but without proper oral tentacles. Branchiæ generally ramose, retractile with the anus into a common cavity.

DORIOPSELLA, Bergh. Distinct from Doridopsis by its somewhat rigid and granulated mantle. *D. areolata*, Bergh.

FAMILY POLYCERIDÆ.

Mantle small or obsolete, generally with marginal appendages, integument usually spiculose. Rhinophores various, often laminated. Messrs. Alder and Hancock divide the Polyceridæ into two sections, according as the rhinophores are retractile or non-retractile. This gives a convenient arrangement.

§ A: Rhinophores retractile within sheaths; the odontophore broad. (*Euryglossæ*.)

MIAMIRA, Bergh, 1874.

Distr.—*M. nobilis*, Bergh. Australasia.

Mantle (nothæum) anteriorly produced into a frontal veil, and furnished with lateral flattened lobes, lamellate below, behind continued into a caudal veil, above keeled and with transverse ribs. Oral aperture armed with a spinous buccal collar. Odontophore broad, with numerous series of teeth, many of them multidentate; the rachis armed.—BERGH.

CASELLA, H. and A. Ad.

Distr.—2 sp. Australasia. *C. Gouldii*, H. and A. Ad. (xc, 2).

Body compressed, elongated. Mantle-margin small, forming undulated lobate or erect crests along the sides of the back.

Rhinophores laminated, retractile. Foot narrow. Oral aperture armed. Odontophore with numerous minute spines, none median.

KALINGA, Ald. and Hanc., 1864. Body oval, subprismatic. Margin of mantle most developed in front, where there is a row of close-set papillated processes extending over the head; a few similar processes are upon the sides of the back. Rhinophores laminated. Oral tentacles flattened. Branchiæ non-retractile, placed separately in a circle at some distance around the anal opening. Odontophore broad, with numerous rather distant rows of tricuspid spines. No jaws or collar. *Distr.*—*C. ornata*, A. and H. Coromandel Coast.

TRIOPA, Johnston, 1838.

Syn.—Tritonia, Lam., 1801. Themisto, Oken (part), 1815. Euplocamus, Philippi, 1836 (part). Cadophora, Gray, 1840.

Distr.—9 sp. Universal. *T. claviger*, Müll. (xc, 3).

Body more or less depressed; mantle small, covering the head, the margin with linear subclavate or branched appendages; rhinophores laminated; oral tentacles cylindrical or ovoid; branchiæ few, non-retractile. Odontophore broad, with numerous plates, the two or three inner ones with large spines, none central.

Triopa was instituted by Johnston for the *Doris clavigera* of Müller. Messrs. Alder and Hancock proposed to retain as well the genus Euplocamus for *E. croceus*, Philippi. The differences between the two genera, however, appear to be more of degree than kind, and serve better for distinguishing sections of one genus; moreover the latter name is in general use for a genus of insects as well as for a genus of birds. Euplocamus originally took in the Idaliæ. Oken's Themisto included *Polycera quadri-lineata* and *Triopa clavigera*.

LATERIBRANCHIÆA, Stearns. Animal like Triopa, with a single series of gills on each side, central or subcentral and opposite. *L. festiva*, Stearns. California.

TRIOPELLA, Sars.

Distr.—*T. incisa*, Sars. Norway.

Distinct from Triopa by the broad mantle, which is bilobed behind, and has two longitudinal ridges on the back; radula like that of Ægirus.

TRIOPHA, Bergh, 1880.

Distr.—*T. Carpenteri*, Stearns. W. Coast of America.

Distinguished from Triopa by nodose or shortly ramose dorsal appendages and ear-shaped lower tentacles; five tripinnate branchial plumes; mouth with two strong horny plates. Radula with 3-4 lateral and 10-11 external (uncinal) plates on each side.

ISSA, Bergh.

Syn.—Colga, Bergh.

Example.—*I. lacera*, Bergh.

Frontal and dorsal appendages less developed than in *Triopa*, mouth with triangular jaw. Lingual armature consisting of a median row of plates, two strong lateral and seven external plates.

HETERODORIS, Verrill and Emerton, 1882.

Distr.—*H. robusta*, V. and E. Martha's Vineyard, Mass.

Form and general appearance like *Triopa* and *Triopella*, but stouter and without any trace of gills; mantle forming an edge all around the back; surface of the back with scattered papillæ; a longitudinal crest between and behind the dorsal tentacles, which are lamellose and retractile, without sheaths, but with a prominent fold of the mantle-margin in front of them; head large, rounded, with a free, thin margin, which has a flat tentacular lobe on each side; foot broad, rounded in front; a large opening, apparently the anus, on the right side between the mantle and the foot, behind the middle; verge, as protruded, stout, cylindrical, swollen and rounded at the end, not armed; a short, stout, conical papilla just behind its base, and a lobe below it; farther back, nearer the anal (?) opening, there is a small, simple opening, probably urinal. Odontophore broad, with very numerous small, strongly hooked acute teeth in each row, all similar except a few near the centre, which are less curved and not so acute; no median tooth.

THECACERA, Flem., 1838.

Distr.—3 sp. W. Coast of Eur. *T. pinnigera*, Mont. (xc, 4).

Body limaciform, smooth; mantle obsolete; supracapital veil indistinct; rhinophores laminated; no oral tentacles; branchiæ non-retractile, with linear or tubercular lateral appendages. Odontophore broad, with 12–14 plates; the two inner on each side bearing bicuspid spines; no central plate. Small lateral corneous jaws.

CRIMORA, Ald. and Hanc., 1862.

Distr.—*C. papillata*, A. and H. Guernsey.

Body limaciform. Mantle nearly obsolete, forming a supra-capital veil with branched appendages, and a papillated ridge along each side of the back. Rhinophores laminated. Oral tentacles tubercular. Branchiæ non-retractile, placed about two-thirds down the centre of the back. Tail short, without a dorsal carina. Odontophore broad, bearing 26 or 27 spines on each side, of three kinds: the inner one is large, hooked, and bicuspid; the next 5 or 6 are short and obtuse, and supported on quadrilateral plates; the rest very long, slender, and minutely denticulated on the inner margin. No central spine.

PLOCAMOPHORUS, Rüppell and Leuckart, 1828.

Syn.—Plocamoceros, Cuv., 1830. Plocamophorus, Gray, 1842. Peplidia, Lowe, 1842. Histiophorus, Pease, 1860.

Distr.—10 sp. Red Sea, Australasia. *P. ocellatus* (xc, 5).

Body limaciform. Mantle represented by a supracapital veil bearing tuberculate or branched appendages on the margin, and by two or three tubercular processes upon each side of the back. Rhinophores laminate. Oral tentacles flat. Branchiæ few, non-retractile. Tail dorsally carinated. Odontophore with the spines near the middle bicuspid, none median in position. An incomplete buccal collar.

ÆGIRUS, Lovén, 1846.

Distr.—3 sp. European coasts. *Æ. punctilucens*, d'Orb. (xc, 6, 7).

Body convex, covered with large tubercles. Mantle indistinct, represented by a supracapital veil, and by a tubercular ridge along each side. Rhinophores linear, smooth or hispid. Branchiæ non-retractile. Odontophore with simple, curved, lateral spines; no central spine. An upper corneous jaw.

NOTODORIS, Bergh, 1875.

Distr.—*N. citrina*, Bergh. Rarotonga.

Body limaciform (the back not distinct from the sides). Rhinophores smooth, retractile in cavities protected by valves. No buccal armature. Lingual teeth, none median, the lateral ones erect and hook-shaped.—BERGH.

CERATOSOMA, Ad. and Reeve, 1848.

Distr.—8 sp. Australasia and Canary Isles. *C. cornigerum*, Ad. and Reeve (xc, 8).

Body elongate, prismatic, smooth, ending in a bluntly pointed tail; the dorsal surface passes into a post-branchial flesh protuberance. Mantle obsolete. Rhinophores laminated. Branchiæ with the roots more or less coherent, placed in front of and partially around the tubular anus, with which they are retractile into a common, smoothly margined cavity. Odontophore with numerous rows of simple spines, none of which are central. A spinous buccal collar.

TREVELYANA, Kelaart, 1858.

Syn.—Gymnodoris, Stimpson, 1855. Stenodoris, Pease, 1866.

Distr.—11 sp. Red Sea, Indian Ocean and Australasia. *T. Ceylonica*, Kelaart (xc, 9).

Body limaciform, rather swollen or raised on the central region. Mantle obsolete; no appendages; rhinophores laminated and

retractile; branchiæ pinnate and non-retractile, placed round the anus almost on the centre of the back. Mouth without oral tentacles or veil, and without collar or jaws; odontophore broad, bearing simple spines.

NEMBROTHA, Bergh.

Distr.—6 sp. Pacific. *N. nigerrima*, Bergh.

Body limaciform, back and sides not separated; tentacles short, lobiform; branchiæ not retractile, sparsely foliate, almost in the middle of the back; foot narrow; labial armature small or none (?).

§ B. Rhinophores non-retractile; odontophore narrow. (*Stenoglossæ*.)

GONIODORIS, Forbes, 1840.

Syn.—Doriprismatica, d'Orb., 1837 (part). Pelagella, Gray, 1850.

Distr.—9 sp. Universal. *G. nodosa*, Mont. (xc, 10).

Body rather depressed; mantle distinct with wavy or scalloped margin. Rhinophores laminated; oral tentacles flattened; branchiæ non-retractile; odontophore with four plates in each transverse row; the two next the median line bearing each a large spine; no central plate. A spinous buccal collar.

AETHEDORIS, Abraham, 1876.

Distr.—*A. Indica*, Ald. and Hanc. Madras Coast.

Alder and Hancock figure in vol. 5 of the Zoological Society's Transactions, a form belonging to a new genus "apparently related to Goniodoris." As no specimen came into their hands, they could give no description. The most striking characteristic seen in the drawing is the expansion of the bilobed head, each lobe being semicrescentic, with the apex curved backwards and the margin bearing twelve to fourteen conical dentations.

IDALIA, Leuckart, 1828.

Syn.—Euplocamus, Philippi, 1836 (part).

Distr.—8 sp. Europe and China. *I. aspersa*, Ald. and Hanc. (xc, 11).

Body convex, smooth. Mantle indistinct, the margins bearing filaments, generally longest in front. The head is produced anteriorly. Rhinophores linear, laminated. Branchiæ simply pinnate, non-retractile. Odontophore with four spines in each transverse row, the two middle ones large, no central spines. A spinous buccal collar.

IDALIELLA, Bergh, 1881. Differs in the absence of cirri in the middle of the back, and in the lateral lamellæ of the hooklets on the lips. *I. inæqualis*, Forbes and Hanley.

ANCULA, Lovén, 1846.

Syn.—Miranda, Ald. and Hanc., 1847. *Drepania*, Lafont, 1874.

Distr.—3 sp. N. Atlantic O. *A. cristata*, Ald. and Hanc. (xc, 12).

Body limaciform, smooth. Mantle obsolete, forming an indistinct ridge near the branchiæ, bearing one or more appendages. Rhinophores laminate, bearing styliform basal appendages. Head produced at the sides into tentacular processes. Odontophore with four spines in each transverse row, the two next the median line large and broad, with the inner margin denticulated; no central spine. A spinous buccal collar.

M. Lafont states his *Drepania* to differ from *Ancula* in the head bearing two elongated tentacles analogous to those of *Eolis*, in the branchiæ not being surrounded by linear appendages, and in the rhinophore carrying but one filament instead of two. Unless the lingual character proves to be importantly different from that of *Ancula*, it would seem advisable to unite *Drepania* with the latter genus.

POLYCERA, Cuv., 1817.

Syn.—Themisto, Oken, 1815 (part). *Cufæa*, Leach, 1820.

Distr.—11 sp. Europe, Cape of Good Hope, Australasia. *P. quadrilineata*, Müll. (xc, 13).

Body limaciform. Mantle indistinct, forming a supracapital veil, and a tuberculated ridge on the sides. Rhinophores laminated. Branchiæ non-retractile, with lateral appendages. Odontophore with twelve to sixteen plates in each transverse row, the two near the centre large and bicuspid; no central spine. Lateral corneous jaws.

PALIO, Gray. Frontal veil short, bilobed, tuberculated on the edge; gills branched, with more than one tubercular appendage on each side. *P. ocellata*.

POLYCERELLA, Verrill, 1880. Body elongated-ovate, having the same form as *Polycera*. Mantle little developed. Dorsal tentacles (rhinophores) not laminated and not retractile, without sheaths. A row of papillæ along each side of the back, extending beyond the gills. Gills three, pinnate, situated in the middle of the back, nearly as in *Polycera*. Foot auricled. Odontophore with six rows of teeth; median row absent; inner laterals large, curved, with three denticles, two outer rows much smaller, simple, hook-shaped. *P. Emertoni*, Verrill. New England.

BRACHYCHLANIS, Ehrenb., 1831.

Distr.—*B. pantherina*, Ehrenb. Red Sea.

Mantle very small, forming a dorsal area, with narrow, upturned border. Rhinophores laminated, arising in front of the mantle-margin. Branchiæ retractile. Mouth terminal.

SUBORDER AIOLOBRANCHIATA.

Branchiæ variable, generally upon the sides of the back; not as in the last family, in a circle surrounding the anal orifice.

FAMILY TRITONIADÆ.

Animal with laminated, plumose, or papillose gills, arranged along the sides of the back; tentacles retractile into sheaths; lingual membrane with one central and numerous lateral teeth; orifices on the right side.

TRITONIA, Cuvier.

Syn.—Candiella, Gray.

Distr.—20 sp. Northern seas, Polynesia, Red Sea. Under stones at low-water to 25 fathoms. *T. Hombergii*, Cuvier, found on the English scallop-banks, attains a length exceeding 6 inches. *T. plebeia*, Johnst. (xc, 14).

Animal elongated; tentacles with branched filaments; veil fimbriately digitated; gills in single series on a ridge down each side of the back; mouth armed with horny jaws; stomach simple, liver compact.

MARIONIA, Vayssiere, 1879. Body elongate, sides compressed, mantle none; velum small, ramose, in a dorsal line; maxillæ corneous; stomach armed with cultriform teeth. *T. Berghi*, Vayss. Gulf of Marseilles.

CALIPHYLLA, Costa. Body long, narrow; tentacles two, foliaceous, longitudinally convolute; labial border bilobed; branchiæ foliaceous, vascular, numerous, in irregular, longitudinal series; anus on the right side behind the genital orifice. *Distr.*—*C. Mediterranea*, Costa. Mediterranean.

NEMOCÉPHALA, Costa. Body Tritoniiform; anterior margin of the head semicircular, six-digitate, or divided into six simple, cylindrical tentaculiform processes; tentacles ramose, retractile into sheaths; branchiæ arborescent, on both sides of the back in single longitudinal series. Differs from *Dendronotus* in the six filaments being simple, not branched. *Distr.*—*T. marmorata*, Costa. Mediterranean.

HANCOCKIA, Gosse. Body linear, scarcely palliate, head produced on each side into a broad, flat, many-fingered veil; dorsal tentacles with laminated bulbs, retractile within sheaths; branchiæ three pairs, foliate, pinnatifid, infolding, remotely situated on the subpalliate margin of the back; foot linear, grasping. *Distr.*—*T. eudactylota*, Gosse.

TETHYS, Linn.

Etym.—*Tethys*, the sea (personified).

Syn.—Fimbria, Bohadsch.

Distr.—*T. fimbriata*, L. (xc, 15). Mediterranean. Attains a

foot in length, and feeds on other mollusks and crustaceans.—
CUVIER.

Animal elliptical, depressed; head covered by a broadly expanded, fringed disk, with two conical tentacles, retractile into foliaceous sheaths; gills slightly branched, a single row down each side of the back; reproductive orifices behind first gills, vent on right side, behind second gill; stomach simple.

SCYLLÆA, Linn.

Etym.—*Scyllæa*, a sea-nymph.

Distr.—7 sp. Atlantic, South Britain, Mediterranean, Philippines, on floating sea-weed. *S. pelagica* (xc, 16). *S. Grayi*, Ads. (xc, 17).

Animal elongated, compressed; foot long, narrow, and channeled, adapted for clasping sea-weed; back with two pairs of wing-like lateral lobes, bearing small tufted branchiæ on their inner surfaces; tentacles dorsal, slender, with lamellated tips, retractile into long sheaths; lingual teeth 24·1·24, denticulated; gizzard armed with horny knife-plates; orifices on the right side.

NEREA, Lesson. 10 lines long, with ear-shaped tentacles, and 3 pairs of dorsal lobes. *N. punctata*, Lesson.

MELIBE, Rang.

Syn.—Chiorhæa, Gould.

Distr.—*M. rosea*, Rang (xc, 18). *M. (Chiorhæa) leonina*, Gld. (xci, 19).

Head unusually large, upper tentacula or rhinophoria retractile, perfoliate; pharynx with a strongly toothed jaw, but without radula; back with unequal leaf-, tree- and club-shaped papillæ; no distinct gills.

DENDRONOTUS, Alder and Hancock.

Etym.—*Dendron*, a tree, *notos*, the back.

Distr.—Northern; on sea-weed and corallines; low-water to coralline zone. *D. arborescens* (xci, 20).

Animal elongated; tentacles laminated; front of the head with branched appendages; gills arborescent, in single series down each side of the back; foot narrow; lingual teeth 10·1·10; stomach and liver ramified.

LOMANOTUS, Verany.

Syn.—Eumenis, A. and H.

Distr.—3 sp. Britain and Mediterranean, on corallines. *L. Genei*, Verany (xci, 21).

Animal elongated, smooth; head covered with a veil; tentacles clavate, laminated, retractile into sheaths; gills filamentose, arranged along the sides of the back, on the wavy margins of the mantle; foot narrow, with tentacular processes in front; stomach ramified.

BORNELLA (Gray), A. Adams.

Distr.—3 sp. Straits of Sunda, on floating weed; Borneo. *A. digitata*, Ads. (xci, 22).

Animal elongated; dorsal tentacles retractile into branched sheaths; head with stellate processes; back with two rows of cylindrical, branched, gastric processes, to which small dendritic gills are attached; foot very narrow.

SUBFAMILY PROCTONOTINÆ.

Branchiæ superficial, fusiform, on the sides of the back; tentacles simple, without sheaths; tongue broad, teeth many; jaws horny, strong.

PROCTONOTUS, Alder and Hancock.

Syn.—Venilia, A. and H. Zephyrina, Quatref.

Distr.—3 sp. North Atlantic. *P. mucroniferus* (xci, 23).

Animal oblong, depressed, pointed behind; dorsal tentacles 2, linear, simple, with eyes at their base, behind; oral tentacles short; head covered by a small semilunar veil; mouth with horny jaws; papillæ on ridges down the sides of the back and round the head in front; vent dorsal.

ANTIOPA, Alder and Hancock.

Syn.—Janus, Verany.

Distr.—3 sp. Britain, Mediterranean. *A. spinolæ*, Verany (xci, 24).

Animal ovate-oblong, pointed behind; dorsal tentacles lamelated, united at the base by an arched crest; head with a small veil and two labial tentacles; papillæ ovate, placed along the lateral ridges of the back and continuous above the head; vent central, posterior, sexual orifice at the right side; lingual teeth numerous (?).

MADRELLA, Alder and Hancock, 1864.

Example.—*M. ferruginosa*, A. and H.

Differs from the other members of the family in the lateral position of the anus, and the absence of oral tentacles, unless the oral veil be considered such.

SUBFAMILY DOTONINÆ.

Tentacles retractile into sheaths; branchiæ superficial, fusiform, on the sides of the back; tongue narrow, teeth in a single central series.

? Doro, Oken.

Etym.—*Doto*, a sea-nymph.

Distr.—4 sp. Norway and Britain, on corallines in deep water to 50 fathoms. *D. coronata*, Gmel. (xci, 25, 26).

Animal slender, elongated; tentacles linear, retractile into

trumpet-shaped sheaths; veil small, simple; gills ovate, mucated, in single series down on each side of the back; lingual membrane slender, with above 100 recurved, denticulated teeth, in single series; foot very narrow.

The stomach is ramified, and the liver is entirely contained in the dorsal processes, which fall off readily when the animal is handled, and are soon renewed.

GELLINA, Gray. Head simple; papillæ or gills smooth. *D. affinis*, d'Orb. (xci, 27). North Sea.

DOTILLA, Bergh. Distinct from Doto by three rows of plates in the radula.

HERO, Lovén.

Syn.—Clælia, Lovén. *Distr.*—*H. formosa*, Lov.

Animal with no mantle; tentacles two, linear, simple, non-retractile; veil plain, produced at the sides, gills branched or umbellated. Tongue with a large central denticulated spine, and two simple lateral spines. Jaws corneous.

HEROMORPHA, Bergh.

Distr.—*H. Antillensis*, Bergh. West Indies.

Agreeing with Hero in the general structure of the head and especially of the tentacles, but with cup-shaped rhinophores, of which the club is simple; also closely allied to Doto, but with simple papillæ.

FAMILY ÆOLIDÆ.

Animal with papillose gills, arranged along the sides of the back; tentacles subulate, sheathless, non-retractile; lingual teeth 0·1·0; jaws horny; ramifications of the stomach and liver extending into the dorsal papillæ; excretory orifices on the right side; skin smooth, without spicula; no distinct mantle.

SUBFAMILY GLAUCINÆ.

Branchiæ papillose, in groups; foot rudimentary.

GLAUCUS, Forster.

Etym.—*Glaucus*, a sea-deity.

Syn.—Pleuropus, Raf. Eucharis, Peron.

Distr.—7 sp. Atlantic, Pacific. Found on floating sea-weed; devours small sea-jellies, Porpitæ and Velellæ.—BENNET. *G. radiatus*, d'Orb. (xci, 28).

Animal elongated, slender; foot linear, channeled; tentacles four, conical; jaws horny; teeth in single series, arched and pectinated; gills slender, cylindrical, supported on three pairs of lateral lobes; stomach giving off large cœca to the tail and side-lobes; liver contained in the papillæ; sexual orifice beneath first dextral papilla, vent behind second papilla; spawn in a close spiral coil.

GLAUCUS (restricted). Includes the larger species; head small; body slender, with long tail; arms rather short, with the papillæ in one row; penis with a horny hook. 5 sp. Atlantic and Pacific Oceans.

GLAUCILLA, Bergh. Size smaller; head strong; body bulky, with short tail; arms more prominent, with the papillæ in several rows; penis without hook; no large urticating threads. 2 sp. Northern and Southern Pacific.

LANIOGERUS, Blainv. Elongated, subcylindrical; thick and wide anteriorly, narrower and thinner behind; having on each side a series of smooth, finely pectinated lamellæ, divided into two parts; four conical tentacles; generative and anal orifice upon the right side. *G. Elfortii*, Blainv. (xci, 29).

SUBFAMILY ÆOLINÆ.

Foot large; branchiæ in ranks on each side.

ÆOLIS, Cuvier.

Etym.—*Æolis*, daughter of *Æolus*.

Syn.—*Psiloceros*, Menke. *Eubranhus*, Forbes. *Amphorina*, Quatref.

Distr.—Norway, Britain (33 sp.), United States, Mediterranean, South Atlantic, Pacific. *Æ. papillosa*, L.

Animal ovate; dorsal tentacles smooth, oval, slender; papillæ simple, cylindrical, numerous, depressed, and imbricated; mouth with a horny upper jaw, consisting of two lateral plates, united above by a ligament; foot narrow; tongue with a single series of curved, pectinated teeth; spawn of numerous waved coils.

Found amongst rocks at low-water; they are active animals, moving their tentacles continually, and extending and contracting their papillæ; they swim readily at the surface, inverted. They feed chiefly on sertularian zoophytes, and if kept fasting will devour each other; when irritated they discharge a milky fluid from their papillæ, which are very liable to fall off.

FACELINA, Alder and Hancock. (*Acanthopsole*, Trinchese.) Body rather slender, rhinophores perfoliate; anterior angles of the narrow foot assuming the form of tentacles; middle part of the jaw strongly denticulated. (Nearly identical with *Phidiana*, Gray.) *F. coronata*, Forbes (xci, 30). 6 sp. Europe.

PHIDIANA, Gray. Labial tentacles subulate; branchiæ on both sides of the back, composed of cylindrical lobes, forming transverse rows for the whole length of the mantle; orifice tubercular; on the right side, below the first row of branchiæ; edge of jaw with a single row of denticles, and the radula has but few teeth, arranged in a single longitudinal row. Penis pointed. *P. Inca*, d'Orb. (xci, 32).

HERMISSENDA, Bergh, 1878. Near *Phidiana*, but anterior angles

of the foot tentaculiform; jaw with a single row of denticles. Radula consisting of one row of plates, their edge serrulate. Penis without hooks. *H. opalescens*, Cooper. California.

ÆOLIDIA, Cuvier.

Syn.—Æolidiana, Quatr. Cavolina, Brug., Orb. Montagua, Flem.

Distr.—4 sp. European seas. *Æ. annulata*, Quoy (xci, 31).

Rhinophores (upper tentacles) simple; the papillæ compressed, in transverse, rather distant rows; anterior angles of the foot almost rounded; middle projecting piece of the jaw not denticulated. Spawn of one or two coils.

ÆOLIDELLA, Bergh.

Distr.—4 sp. Europe.

Form of the body, tentacles and papillæ like those of *Æolis*; masticatory edge of the jaw minutely plaited; teeth of the radula in one row, comb-like, notched in the middle.

FLABELLINA, Cuvier.

Distr.—6 sp. Mediterranean, Phillipines. *F. coronata*, Forbes.

Body slender, rhinophores perfoliate; tentacles elongated; dorsal papillæ on compressed stalks; foot angularly produced in front; jaws minutely toothed-margined; radula uniserial. Spawn multispiral

PTERÆOLIDIA, Bergh.

Distr.—1 sp. *P. Semperi*, Bergh.

Rhinophores perfoliate; lower tentacles elongated; dorsal papillæ not caducous, on wing-like, compressed pediments; anterior margin of foot inflated, tentacularly produced at the sides; jaws toothed; radula uniseriate; penis unarmed.

CRATENA, Bergh.

Syn.—Cavolina, Brug., part. *Example.*—*C. hirsuta*, Bergh.

Rhinophores simple; anterior angles of the foot rounded; middle part of the jaw minutely denticulated. Spawn arranged in one or two coils.

GONIÆOLIS, Sars.

Distr.—1 sp. Norway.

Animal with a distinct mantle-border, which gives a square form to the body; tentacles not retractile, dorsal very large, labial placed at the sides of a large velum; dorsal papillæ simple, scattered on both sides of the back.

RIZZOLIA, Trinchese.

Example.—*R. peregrina*, Gmelin.

Near Cratena and Facelina by the dorsal appendages being

united on low pedicels; and by the simple, non-perfoliated upper tentacula. Armature of the mouth as in *Facelina*, radula uniserial, each plate crescent-shaped, with six to ten cuspids on either side; penis unarmed.

FAVORINUS, Gray.

Distr.—*F. albus*, Alder (xci, 33). North Sea.

Animal with slender cephalic tentacles knobbed at the extremity; oral tentacles two pairs; papillæ arranged in several oblique rows; jaws denticulated; dentition uniserial.

SPURILLA, Bergh.

Distr.—1 sp. Mediterranean.

Rhinophores perfoliate; anterior angles of the foot almost rounded; middle part of the jaw only, finely denticulated.

CORYPHELLA, Gray.

Distr.—18 sp. New England, Northern Europe. *C. Landsburgi*, Alder (xci, 34).

Rhinophores simple; angles of the foot produced; middle part of the jaw denticulated, lateral teeth of the radula minutely denticulated.

CALMA, Alder and Hancock.

Distr.—North Sea. *C. glaucoides*, A. and H.

Animal sharply angular in front; foot broad; papillæ simple and supported on cylindrical bases; tentacles small; jaws acutely toothed; radula triseriate.

GALVINA, Alder and Hancock.

Distr.—North Sea. *G. tricolor*, Forbes.

Rhinophores simple; papillæ swollen in distant transverse rows; anterior angles of the foot rounded; middle part of the jaw strongly denticulated; lateral teeth of the radula not denticulated.

TRINCHESIA, Ihering. Near Galvina, but only one plate in each transverse row of the radula. Several species at Naples.

CUTHONIA, Alder and Hancock.

Distr.—*C. nana*, A. and H. North Sea.

Animal with head naked and expanded; papillæ clavate and arranged in thick-set rows.

HERVIA, Bergh.

Distr.—1 sp. N. Europe.

Rhinophores simple; foot angularly produced in front; back papillary in oblique series; jaws with a single series of teeth; radula uniserial, sparsely dentate.

MATHARENA, Bergh.

Distr.—1 sp. N. Europe.

Papillæ in transverse and oblique series.

CÆCINELLA, Bergh.

Distr.—*C. luctuosa*, Bergh. Philippines.

Rhinophores sheathed; dorsal papillæ uniserial; with posterior claviform appendices; radula uniserial.

CERBERILLA, Bergh.

Distr.—1 sp. Samoa Islands.

Upper tentacles perfoliate, under tentacles elongate, dorsal papillæ situated on short pedicels; jaw smooth; teeth of the radula in a single row, irregularly denticulated.

FIONA, Alder and Hancock.

Syn.—*Oithona*, A. and H. (not Baird).

Distr.—4 sp. Falmouth. Under stones at low-water.—**DR. COCKS.** *F. nobilis*, A. and H. (xci, 35).

Animal elongated; oral and dorsal tentacles linear; mouth armed with horny jaws; gills (?) papillary, clothing irregularly a subpallial expansion on the sides of the back, each with a membranous fringe running down its inner side.

SUBFAMILY HERMÆINÆ.

Branchiæ papillary; tentacles non-retractile; mouth unarmed, or with corneous jaws.

ALDERIA, Allman.

Etym.—Named after Joshua Alder, one of the authors of the "Monograph on the British Nudibranchiate Mollusca."

Syn.—*Styliger*, Lovén.

Distr.—4 sp. Norway, South Ireland, and South Wales. *A. modesta*, Lovén (xci, 36).

Animal oblong, without tentacles; head lobed at the sides; papillæ arranged down the sides of the back; vent dorsal, posterior.

ERCOLANIA, Trinchese.

Distr.—3 sp. Mediterranean.

Body subcylindrical; head small, without velum; foot narrow, with rounded anterior angles; branchiæ numerous, sprinkled with whitish globules; rhinophores long, graceful, very faintly canaliculate; anus in the middle of the back, in front of the heart.

PHYLLOBRANCHUS, Alder and Hancock.

Syn.—*Lobifera* and *Polybranchia*, Pease.

Distr.—5 sp. Ceylon, Red Sea, Philippines, West Indies, Medit. *P. orientalis*, Kel.

Near *Hermæa*; branchiæ leaf-like, with distinct foot-stalks; anus lateral; penis long, without sting.

STILIGER, Ehrenb.

Sny.—*Calliopæa*, Orb.

Distr.—5 sp. Red Sea, Europe, Massachusetts. *S. modestus*, Ehrenb.

Form of the body like that of *Galvina*; rhinophores simple, tentacles tuberculiform; dorsal papillæ club-shaped; foot rounded in front. Penis armed with a sting.

HERMÆA, Lovén.

Distr.—9 sp. Norway, Britain, etc. *H. dendritica*, Alder and Hancock (xci, 37).

Animal elongated, tentacles folded longitudinally; papillæ numerous, arranged down the sides of the back; sexual orifice below right tentacles; vent dorsal, or sublateral, anterior.

CYERCE, Bergh.

Distr.—2 sp. Pelew Islands. *C. elegans*, Semper.

Vent dorsal; foot transversely bipartite; penis short, armed with sting.

EMBLETONIA, Alder and Hancock.

Etym.—Dedicated to Dr. Embleton, of Newcastle.

Syn.—*Pterochilus*, A. and H.

Distr.—4 sp. Scotland (2 sp.). In the littoral and laminarian zones. *E. pulchra*, A. and H. (xci, 38).

Animal slender; tentacles two, simple; head produced into a flat lobe on each side; papillæ simple, subcylindrical, in a single row down each side of the back.

TERGIPES, Cuvier.

Example.—*T. despectus*, Alder (xci, 39).

Tentacles subulate, smooth; branchiæ in a single row on each side, each with a sucker-like extremity; foot rudimentary. Spawn kidney-shaped.

FILURUS, DeKay.

Distr.—*F. dubius*, DeKay.

Foot stunted; body slender; tentacles two; mouth on a loose fringe of skin with two small oral feelers; papillæ in two long rows down the back.

FAMILY ELYSIIDÆ.

Animal shell-less, limaciform, with no distinct mantle or breathing-organ; respiration performed by the ciliated surface of the body; mouth armed with a single series of lingual teeth;

stomach central, vent median, subcentral; hepatic organs branched, extending the length of the body and opening into the sides of the stomach; sexes united; male and ovarian orifices below the right eye; female orifice in the middle of the right side; heart with an auricle behind, and traces of an arterial and venous system, eyes sessile on the sides of the head, tentacles simple or obsolete.

SUBFAMILY ELYSIINÆ.

Body very flat; front narrow; tentacles short, mostly ear-shaped, the edges rolled up; eyes distant; genital orifice double, behind the right tentacle; sides of the back winged, and a pericardio-renal protuberance as in *Placobranchus*; surface of the back smooth, except an elevated line branching to the wings; pharynx and radula nearly as in *Placobranchus*, but usually no crop; penis without sting. The genera are arranged as follows:

ELYSIA, Risso.

Syn.—*Actæon*, Oken, not Montfort. *Aplysiopertus*, Chiaje.

Distr.—7 sp. Europe, Philippines, Pelew Islands. *E. viridis*, Mont. (xci, 40).

Head rounded; tentacles of moderate size; vent anterior, latero-dorsal, dorsal wings not much plaited, without bordering, not continuous on the neck.

TRIDACHIA, Desh. (*Pterogasteron*, Pease.) Wings much plaited and undulated, continuous in front; otherwise like *Elysia*. *E. crispata*, Orsted. West Indies.

THURIDILLA, Bergh. Head rounded, tentacles of moderate size, vent posterior, median. *E. splendida*, Grube. Adriatic Sea.

ELYSIELLA, Bergh. Head carinated at the sides; tentacles minute, conical. *E. pusilla*, Bergh. Pelew Islands.

ALLPORTIA, Tenison-Woods. Body expanded, thin, wholly flattened anteriorly and posteriorly; eyes submarginal. Tasmania.

DIPLOPELYCIA, Mörch, 1872.

Distr.—*D. trigonura*, Mörch. Mediterranean.

Body compressed as in *Scyllæa*; tentacles very strong, fan-shaped, festooned at the edge; no rhinophores, jaw or eyes; dorsal lobes with several fin-like processes; under sides keeled; with similar processes on each side; tail triangular.

SUBFAMILY PLACOBRANCHINÆ.

Body flat, front large, with short ear-shaped tentacles; eyes in the neck, approximate; double genital orifice near the right tentacle; a distinct protuberance behind the neck, containing the

kidney and pericardium, and with the vent on its right side; sides of the back produced in lateral wings, usually bent upwards; upper face of the back with parallel longitudinal folds; foot not distinctly separated from the rest of the body, transversely bipartite in front. Only genus—

PLACOBANCHUS, Hasselt.

Distr.—9 sp. East Indies, Polynesia. *P. ocellatus*, Quoy (xci, 41).

Characters those of the subfamily.

SUBFAMILY LIMAPONTIINÆ.

Body slug-like, minute; head depressed, its sides carinated or produced into simple feelers; eyes separated; no dorsal wings; foot continuous; pharynx as in Elysia; plates of the radula somewhat compressed, with a carinated hook; penis armed with a sting.

LIMAPONTIA, Johnston.

Syn.—Chalidis, Quatref. Pontolimax, Cr.

Distr.—Norway, England, and France, between half-tide and high-water, feeding on Confervæ, in the spring and summer; spawn in small pear-shaped masses, each with 50–150 eggs; fry with a transparent nautiloid shell, closed by an operculum. *L. cærulea*, Quatr. (xci, 42).

Animal minute, leech-like; head truncated in front, with arched lateral ridges on which are the eyes; foot linear.

ACTEONIA, Quatrefages.

Distr.—2 sp. *A. senestra*, Quatr. (xci, 43).

Animal minute, leech-like; head obtuse, with lateral crests proceeding from two short conical tentacles, behind which are the eyes.

CENIA, Alder and Hancock.

Syn.—Fucola, Quoy.

Distr.—*C. Cocksii* (xci, 45).

Animal limaciform, back elevated, head slightly angulated, bearing two linear dorsal tentacles, with eyes at their outer bases behind.

RHODOPE, Kölliker, 1847.

Distr.—*R. Veranii*. Upon algæ, Messina.

Animal minute, similar to Limapontia (?); worm-shaped, rather convex above, flat beneath; without mantle, gills or tentacles. Probably not a mollusk.

FAMILY PHYLLIDIIDÆ.

Branchiæ covered or wanting.

SUBFAMILY PHYLLIDIINÆ.

Limaciform; the branchiæ leaf-like, between the mantle and the foot. No jaws or tongue.

PHYLLIDIA, Cuvier.

Etym.—Diminutive of *phyllon*, a leaf.

Distr.—6 sp. Mediterranean, Red Sea, India, Polynesia. *P. trilineata*, Cuv. (xci, 46).

Animal oblong, covered with a coriaceous tuberculated mantle; dorsal tentacles clavate, retractile into cavities near the front of the mantle; mouth with two tentacles; foot broadly oval; gills forming a series of laminae extending the entire length of both sides; excretory orifice in the middle line, near the posterior end of the back, or between the mantle and foot; reproductive organs on the right side; stomach simple, membranous.

PHYLLIDIELLA, Bergh. Dorsal tubercles rounded and in quincunx order; vent dorsal; pharynx asymmetrical. 3 sp. Philippines, East Indies. *P. pustulosa*, Cuv.

PHYLLIDIOPSIS, Bergh. Vent dorsal, as in *Phyllidia*, tentacles soldered in their whole length to their basis, as in *Doridiopsis*. *P. cardinalis*, Bergh, Tonga.

FRYERIA, Grube.

Distr.—*F. pustulosa*, Rüppell (xci, 47). South Sea, East Africa.

Excretory orifice on the side of the foot under the mantle, which is leathery and watery; six gills entire length of both sides.

HYPOBRANCHIÆA, A. Adams.

Distr.—*H. fusca*, A. Ad. (xci, 48). Japan.

Mantle cuticular; gills limited to the hinder part of the body; excretory orifices at the side, under the mantle.

SUBFAMILY PLEUROPHYLLIDIINÆ.

Limaciform; branchiæ in a fold of the posterior margin of the mantle; tongue armed.

PLEUROPHYLLIDIA, Meckel.

Syn.—*Diphyllidia*, Cuvier. *Linguella*, Blainv. *Armina*, Raf. *Dermatobranchus*, Hasselt.

Distr.—14 sp. Norway, Britain, Mediterranean, India. *P. Cuvieri*, Meckel (xci, 49).

Animal oblong, fleshy; mantle ample; gills limited to the hinder two-thirds of the body; head with minute tentacles and a lobe-like veil; vent at the right side, behind the reproductive orifices; lingual teeth 30·1·30.

SANCARA, Bergh.

Distr.—2 sp. Mediterranean, Japan.

Mantle smooth, not distinctly separated from the body anteriorly; no caruncula tentacularis.

CAMARCA, Bergh.

Distr.—1 sp. Realejo, Central America.

Caruncula tentacularis low, united with the front of the mantle; this latter without urticating organs.

SUBFAMILY PLEUROLEURINÆ.

Without gills.

PLEUROLEURA, Bergh.

Distr.—*P. ornata*, Bergh. Philippines.

Near Pleurophyllidia, but wanting the gills; tentacular shield without caruncles; back broad, its lateral edge with numerous urticatory pores; jaws like those of Pleurophyllidia, but without masticatory process, and with a smooth edge.

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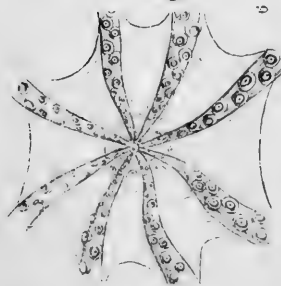
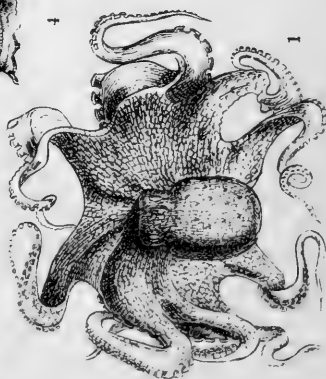
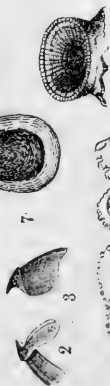
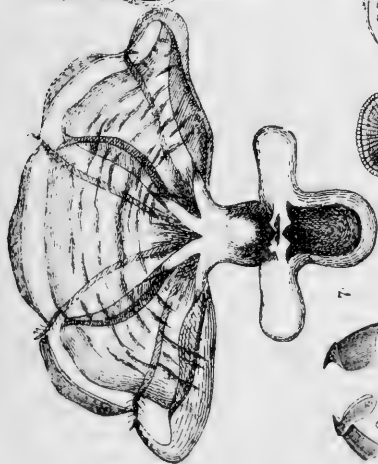
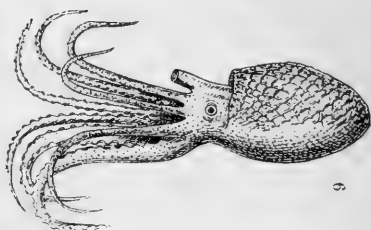
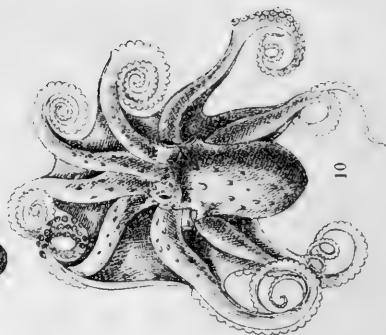
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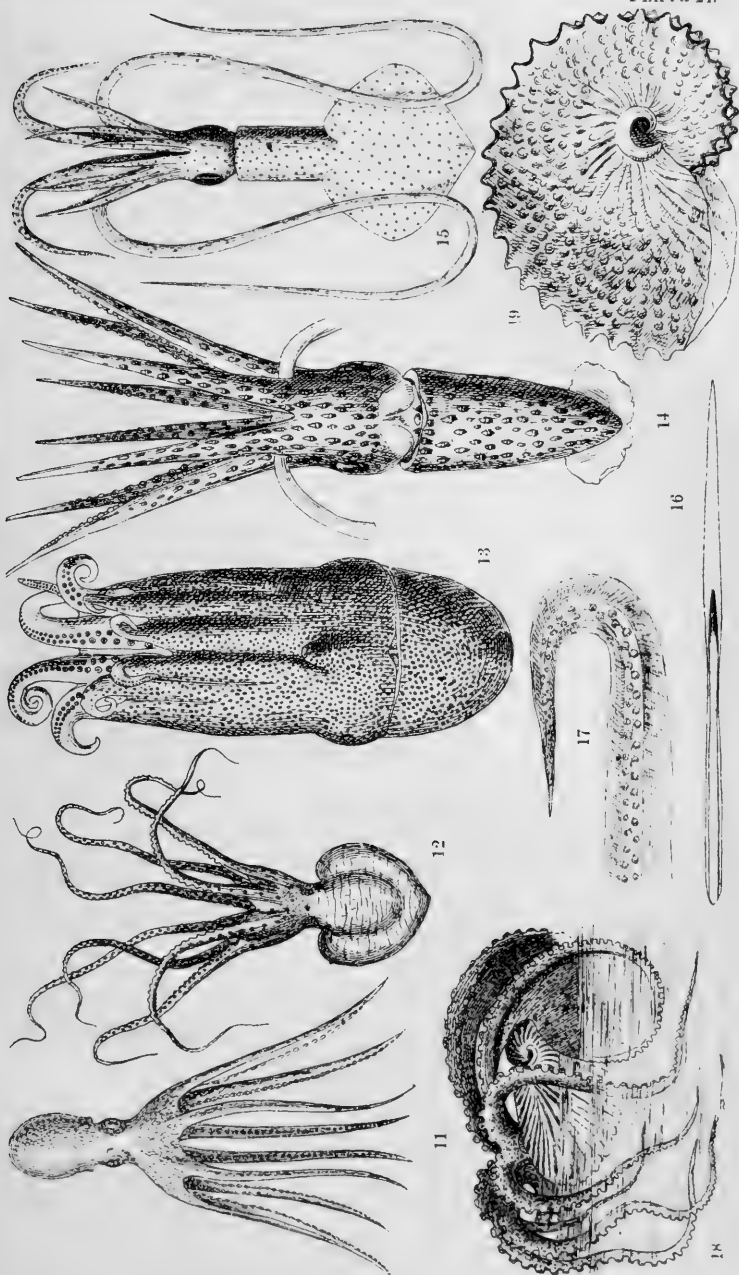
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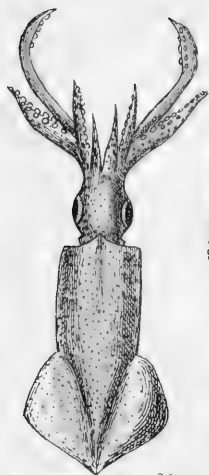
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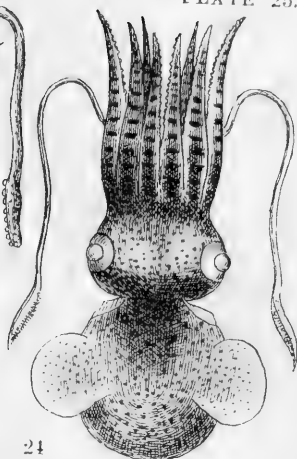
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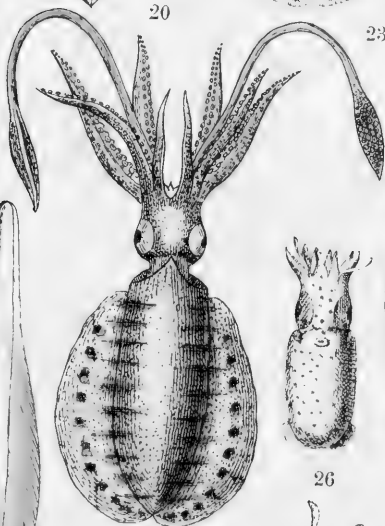




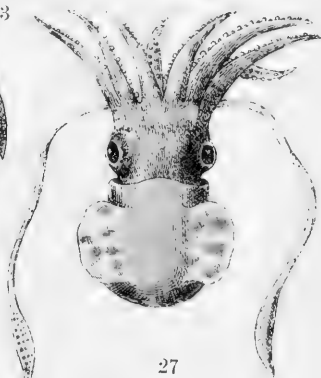
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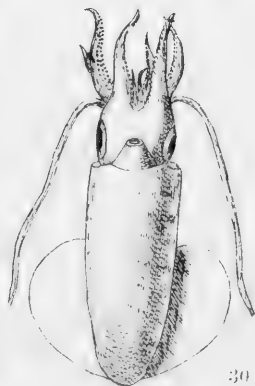
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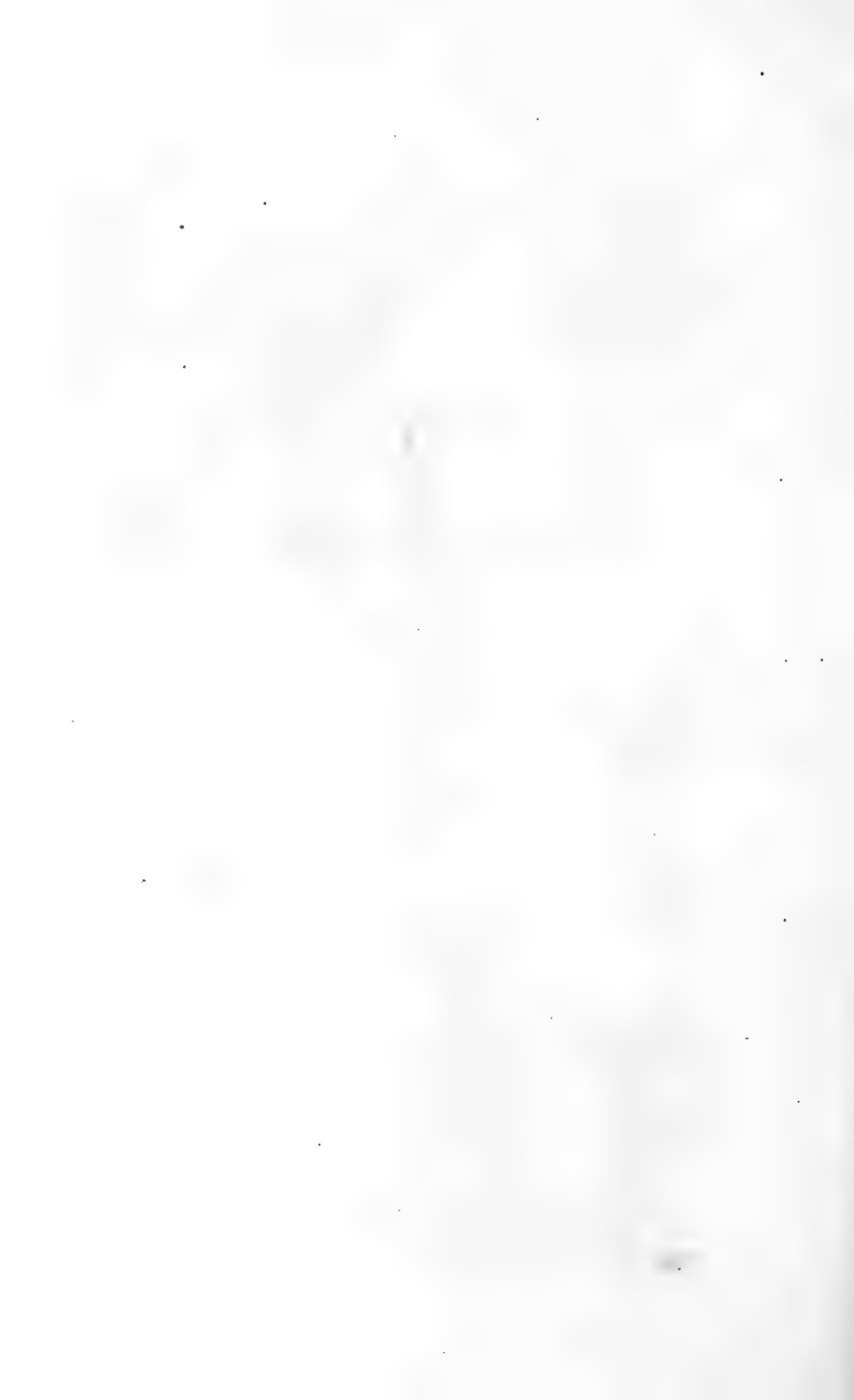


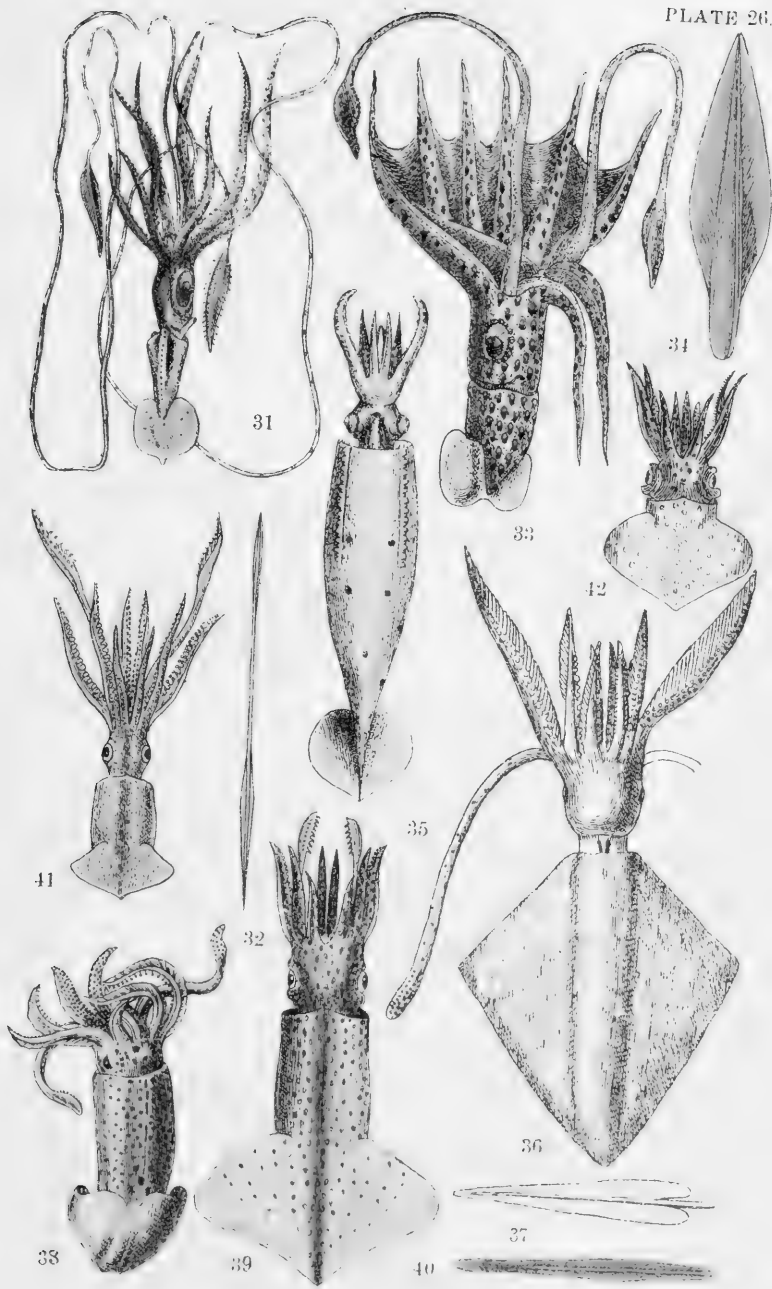
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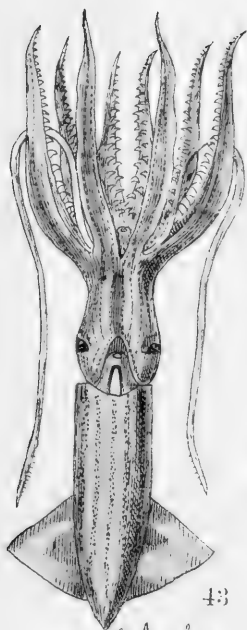


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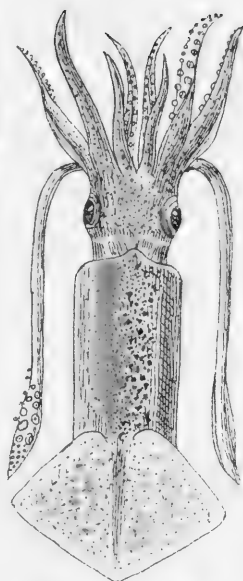
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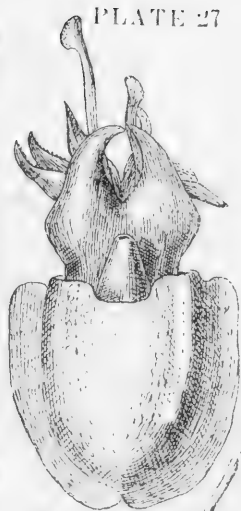




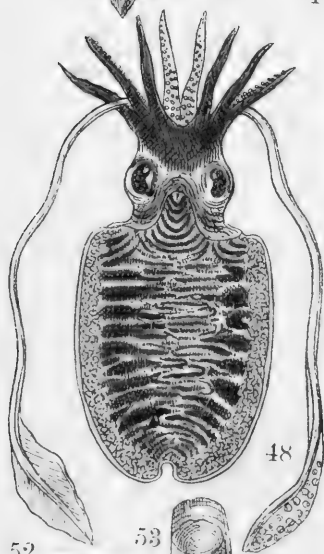
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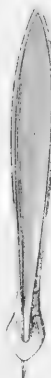
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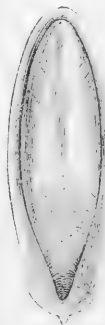
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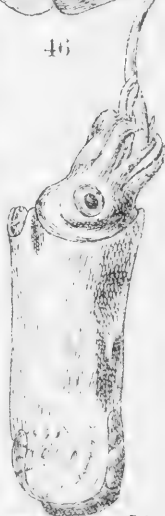
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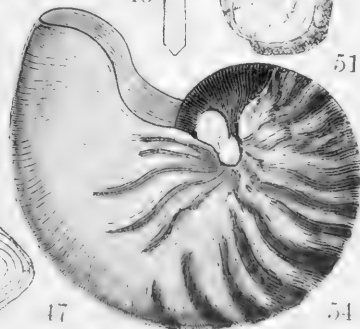
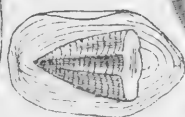
52



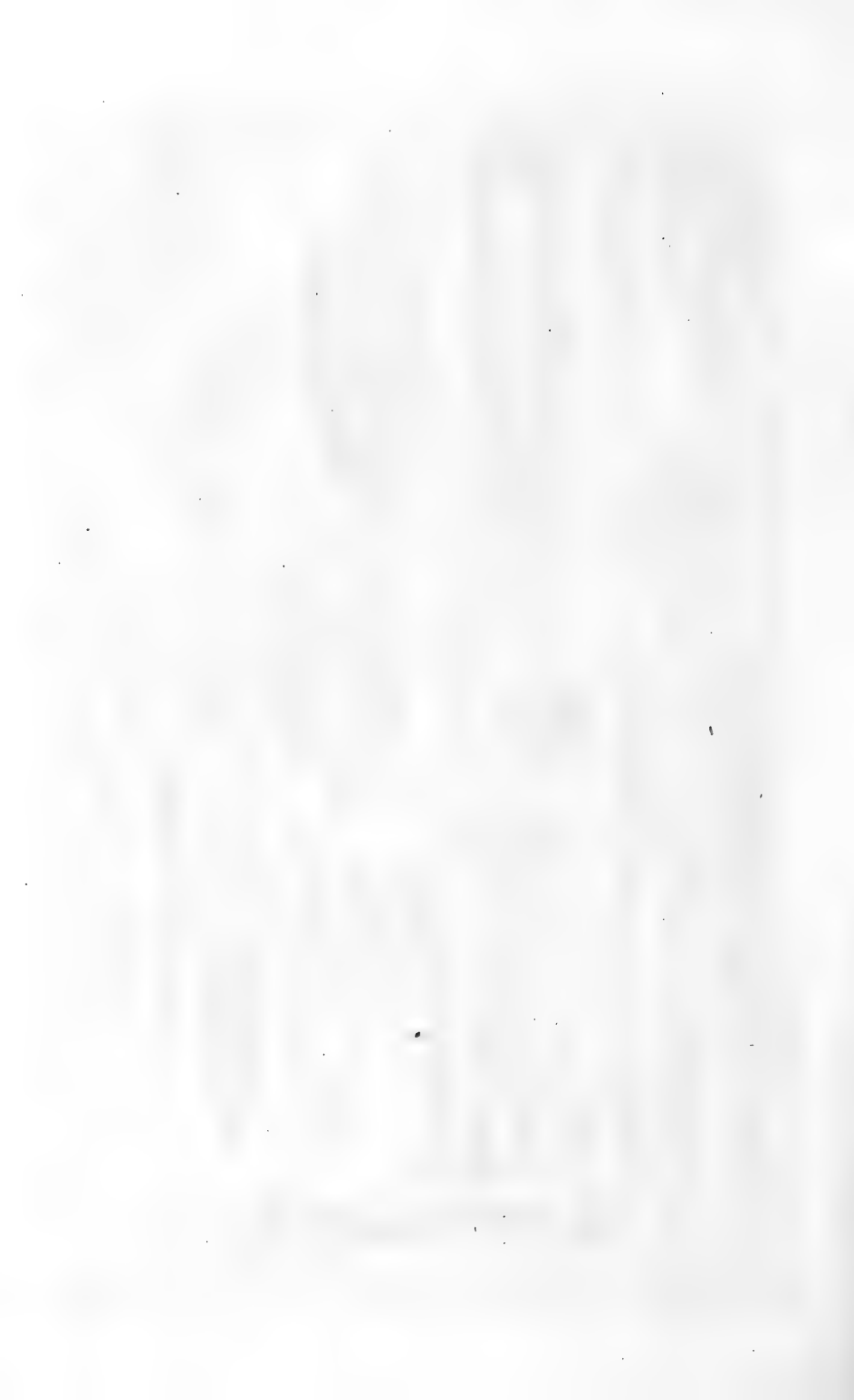
53

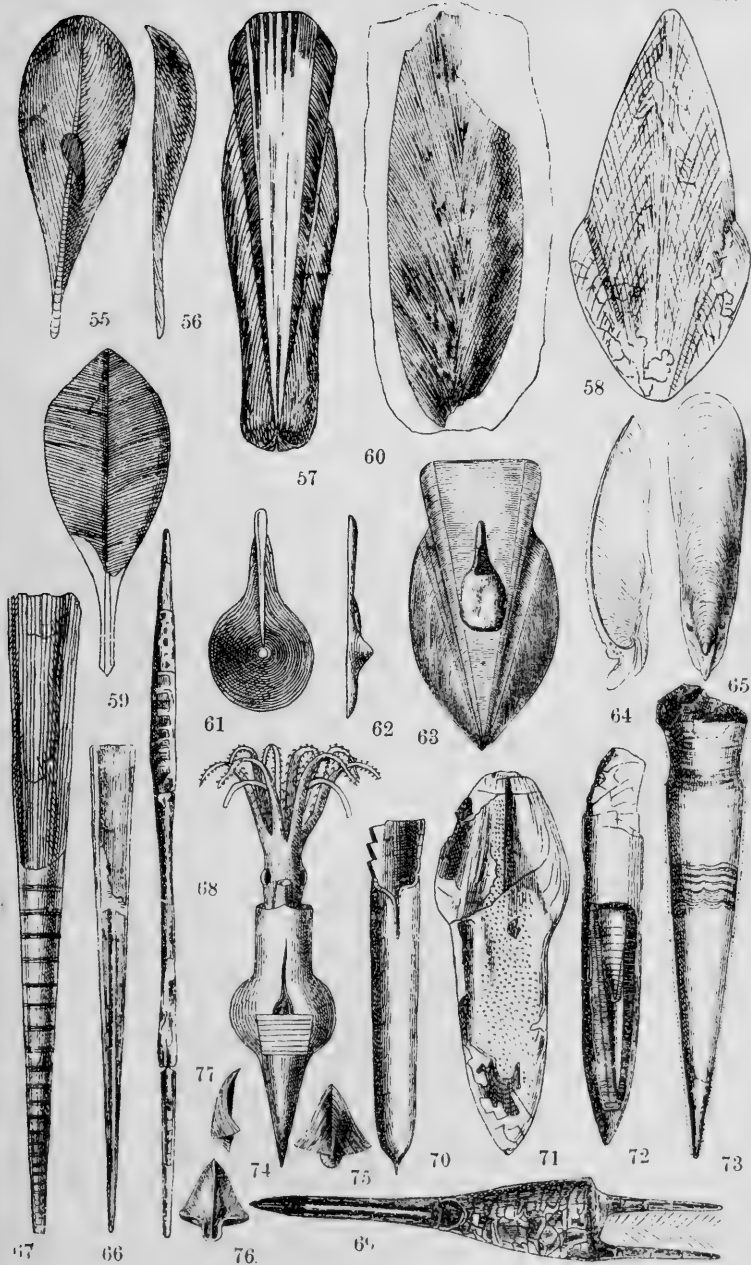


54



56





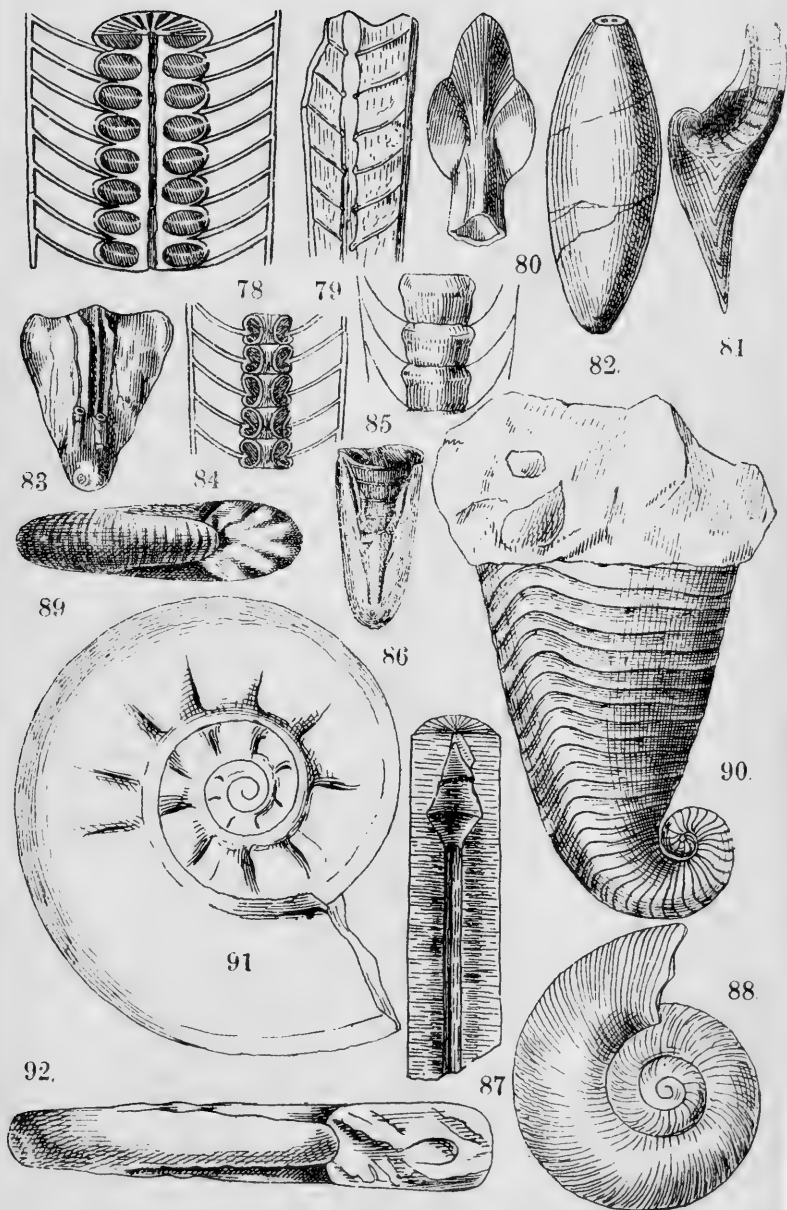
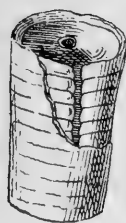


PLATE 30.



93



97



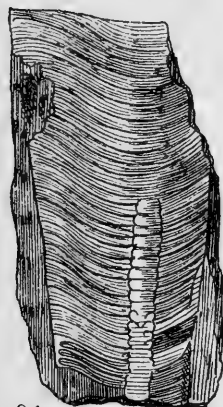
99



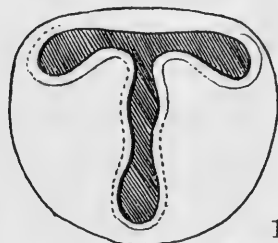
98.



100



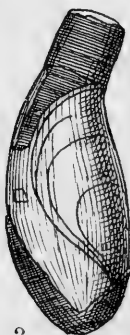
94



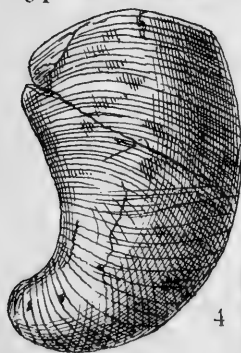
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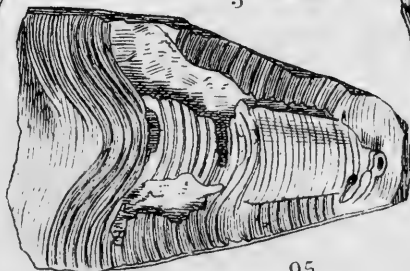
2.



3



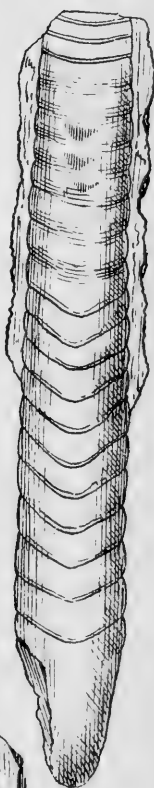
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95

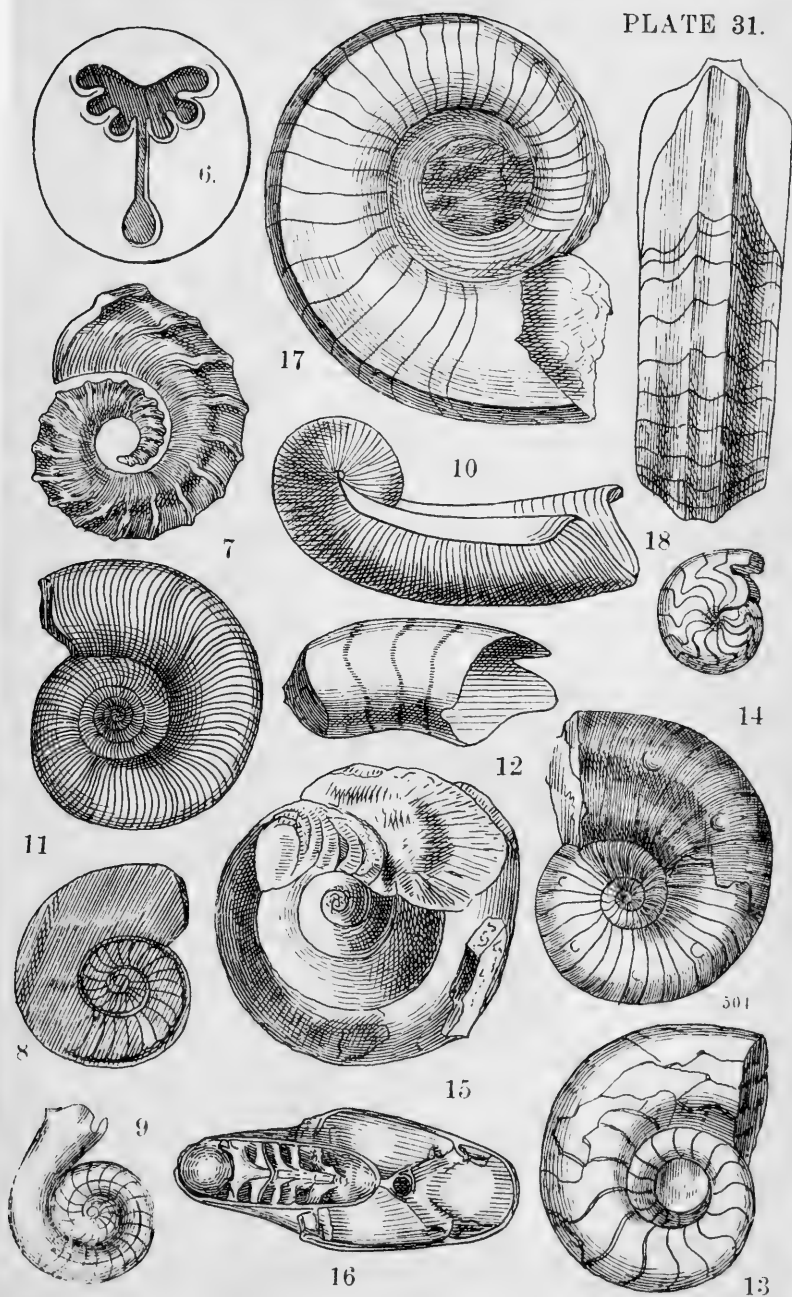


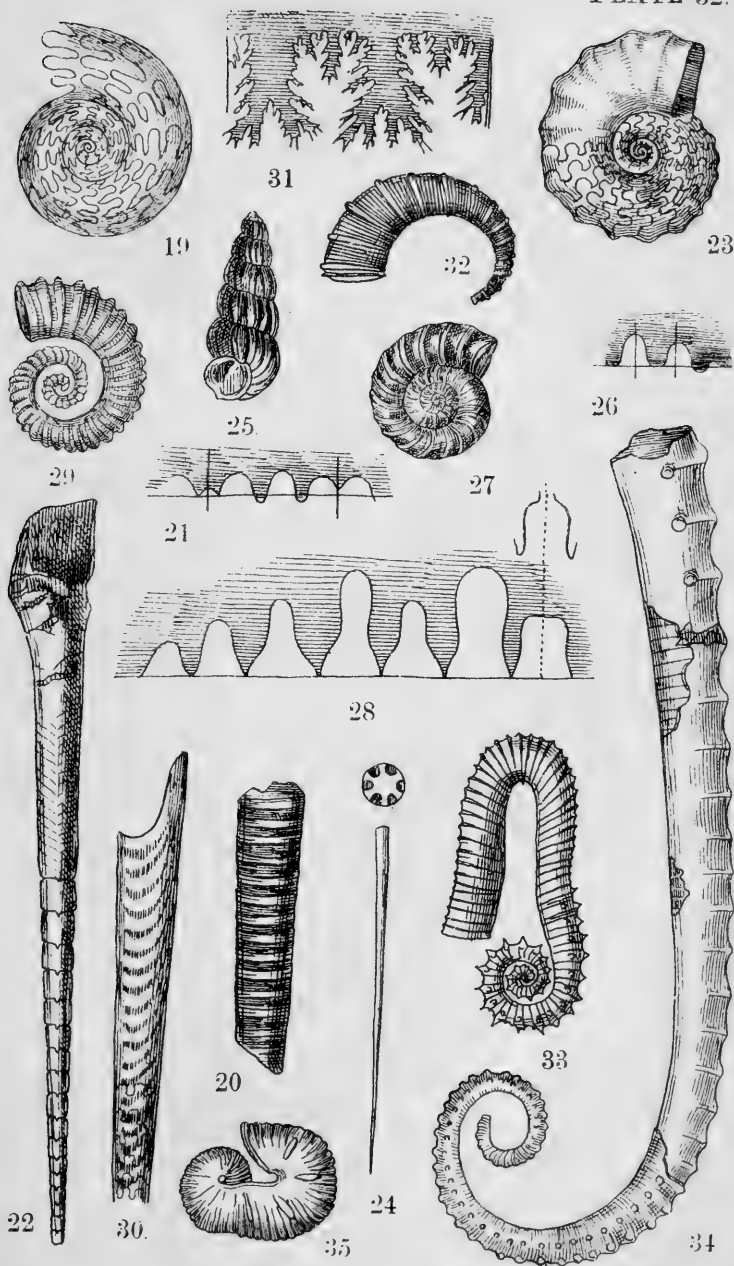
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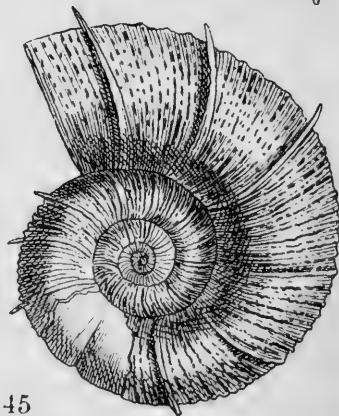
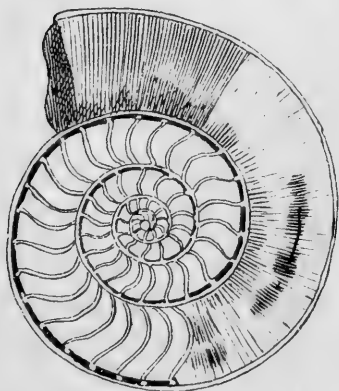
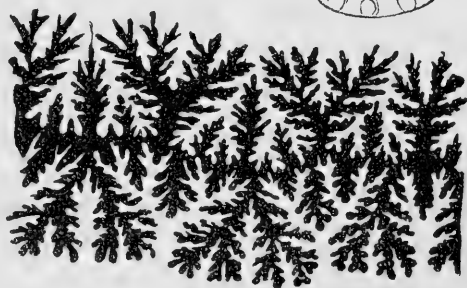
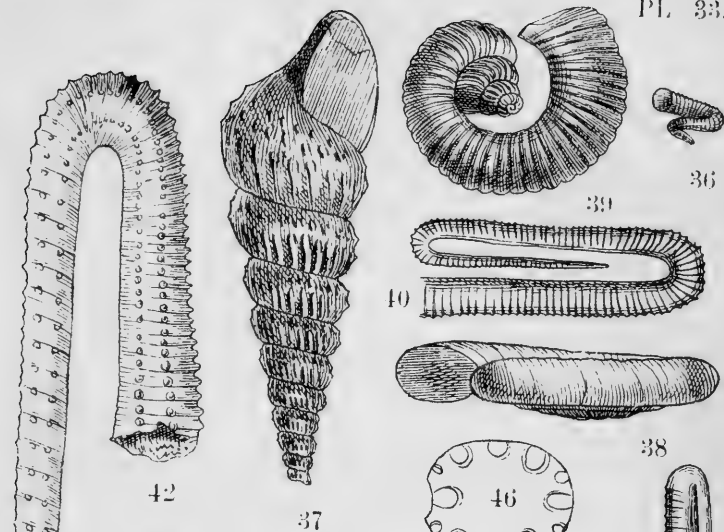


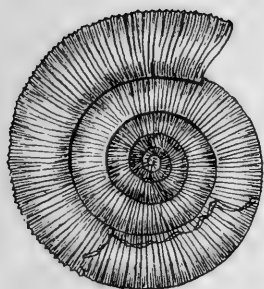
96

PLATE 31.

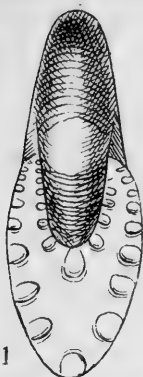




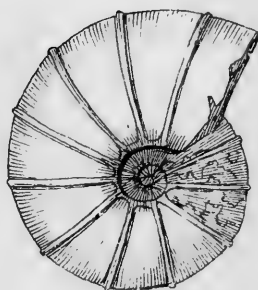




47



51



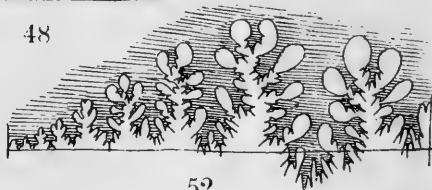
49



48



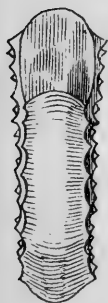
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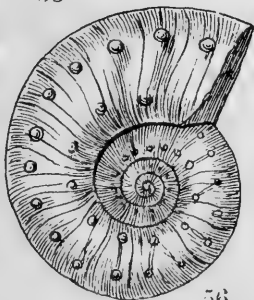
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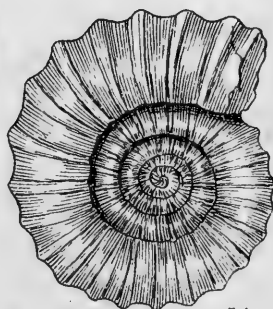
53



58



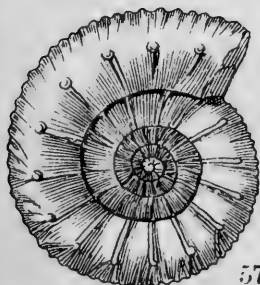
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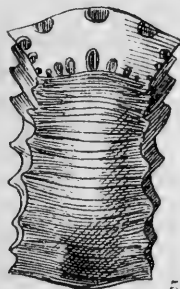
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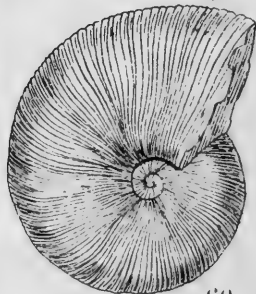
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57

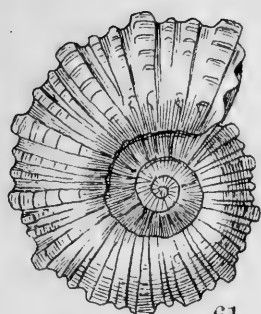


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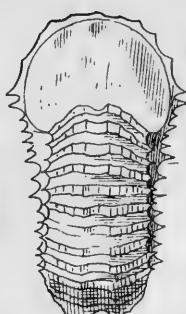


60

PLATE 35.



61



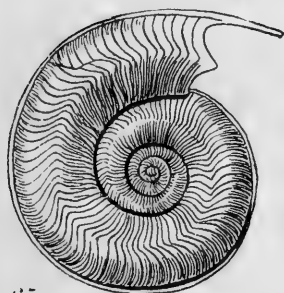
62



66



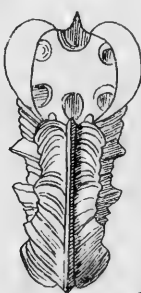
63



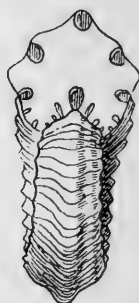
65



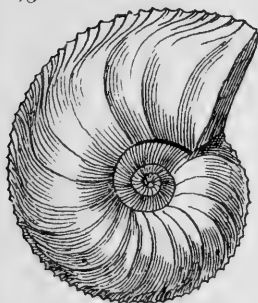
64



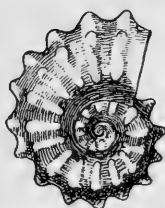
67



69



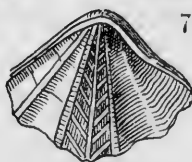
68



70



74



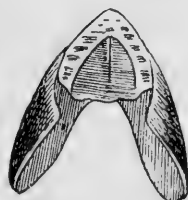
75



72



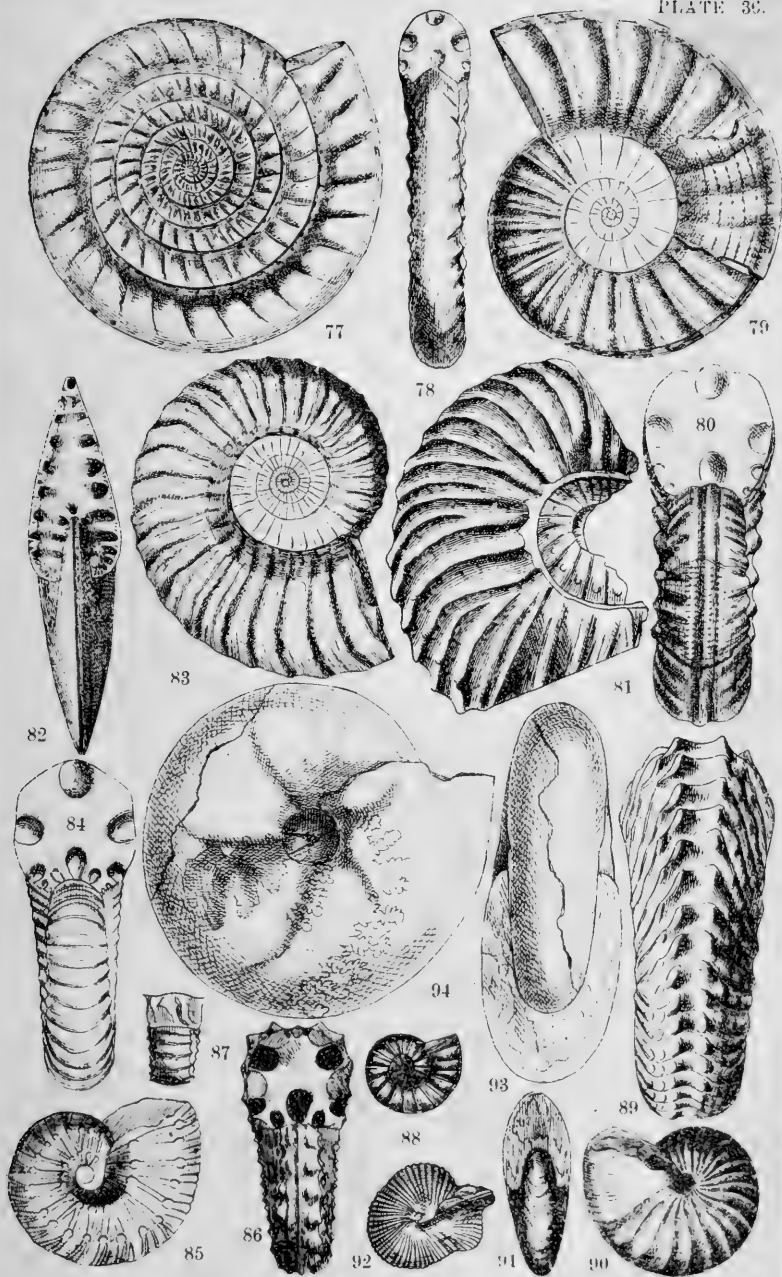
73

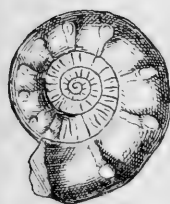


76



71





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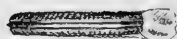
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96



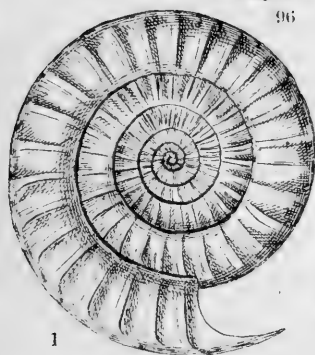
98



99



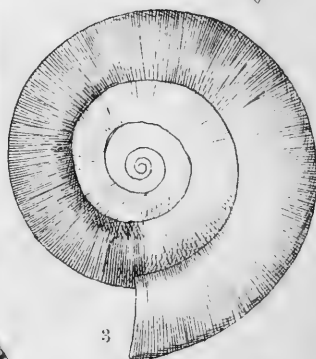
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1



12



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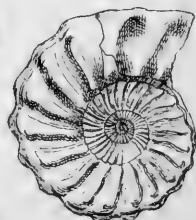
4



5



9



10



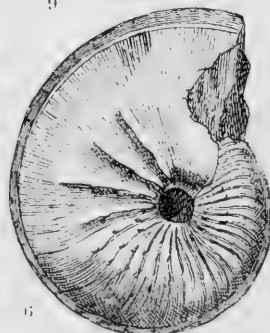
11



6



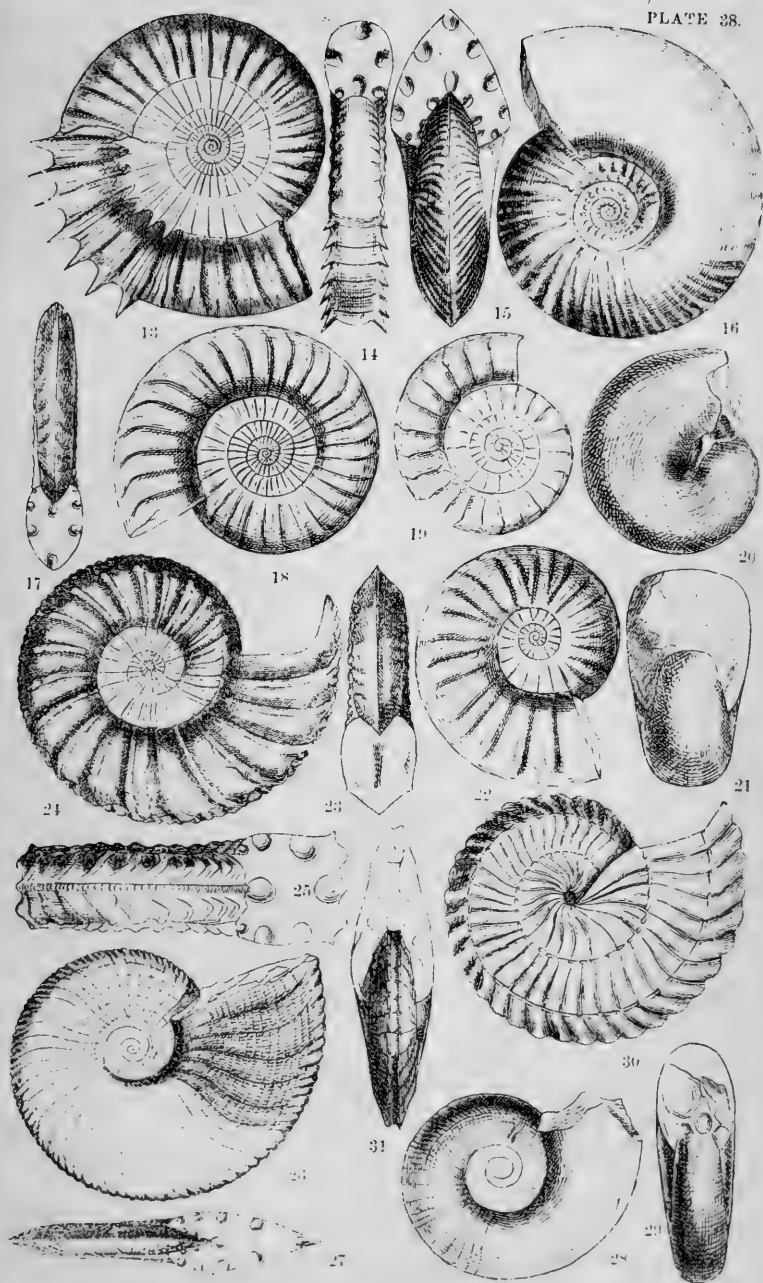
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8

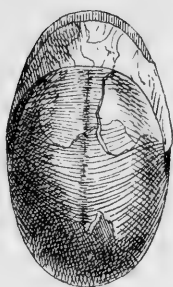


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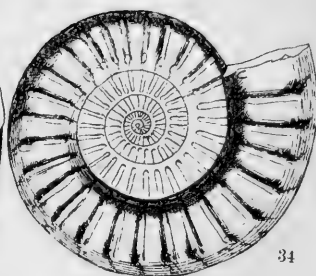




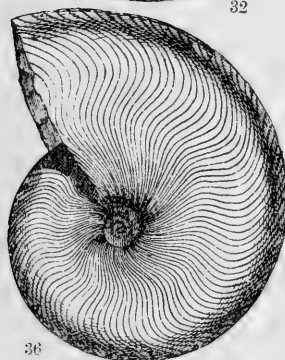
32



33



34



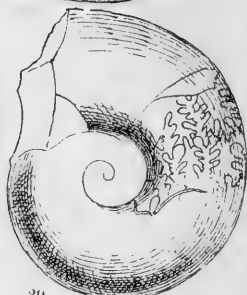
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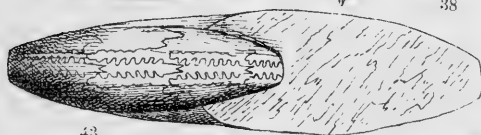
37



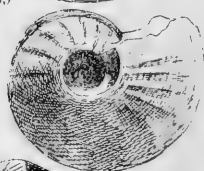
38



39



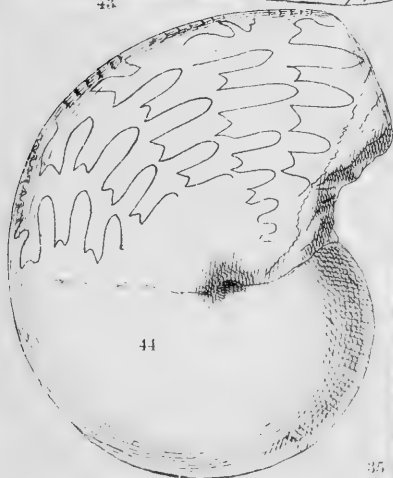
43



40



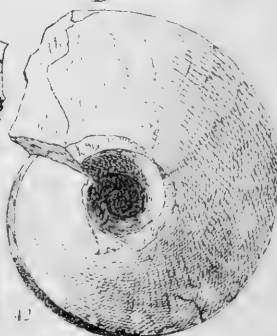
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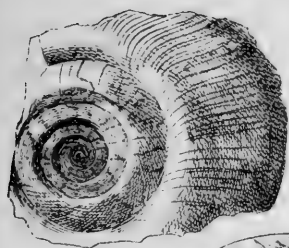
44



35



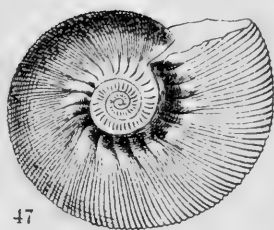
42



45



46



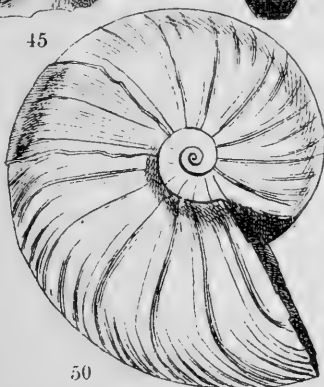
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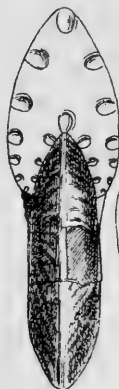
48



49



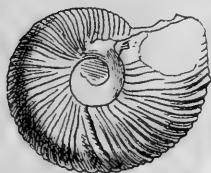
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51



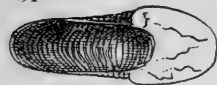
52



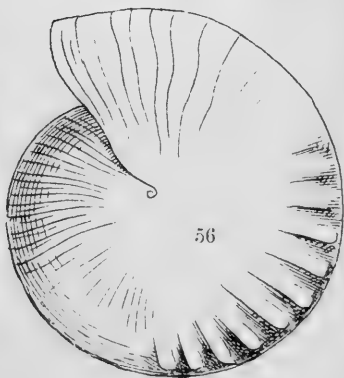
53



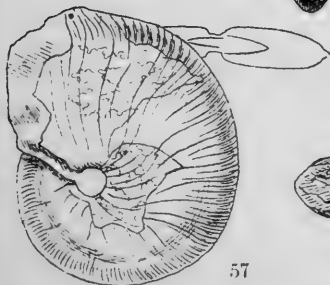
54



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56



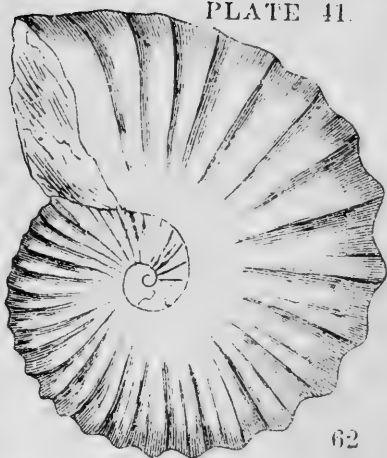
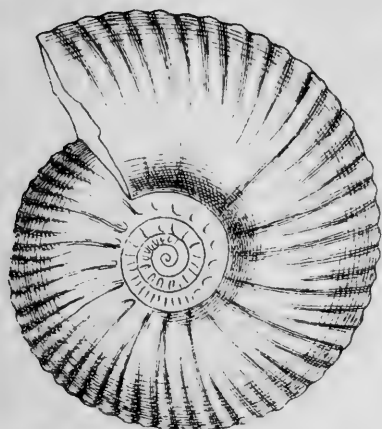
57



58



59

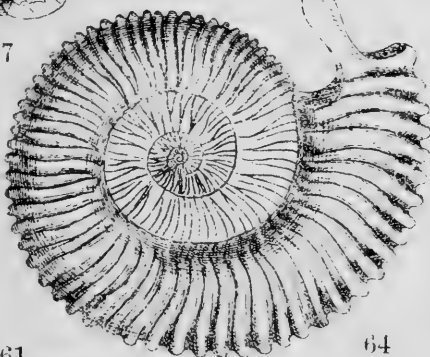


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62

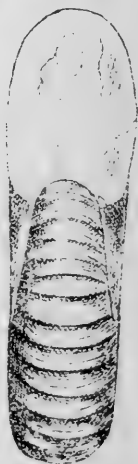


67

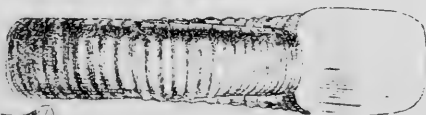


61

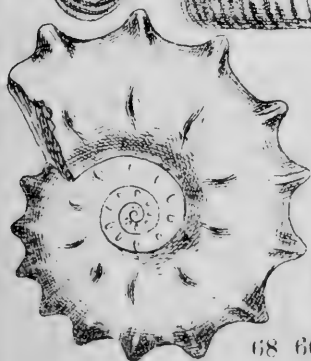
64



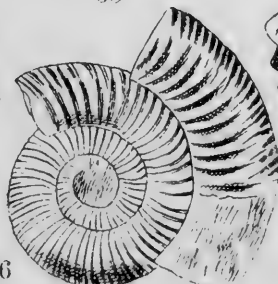
63



65



68 66



69

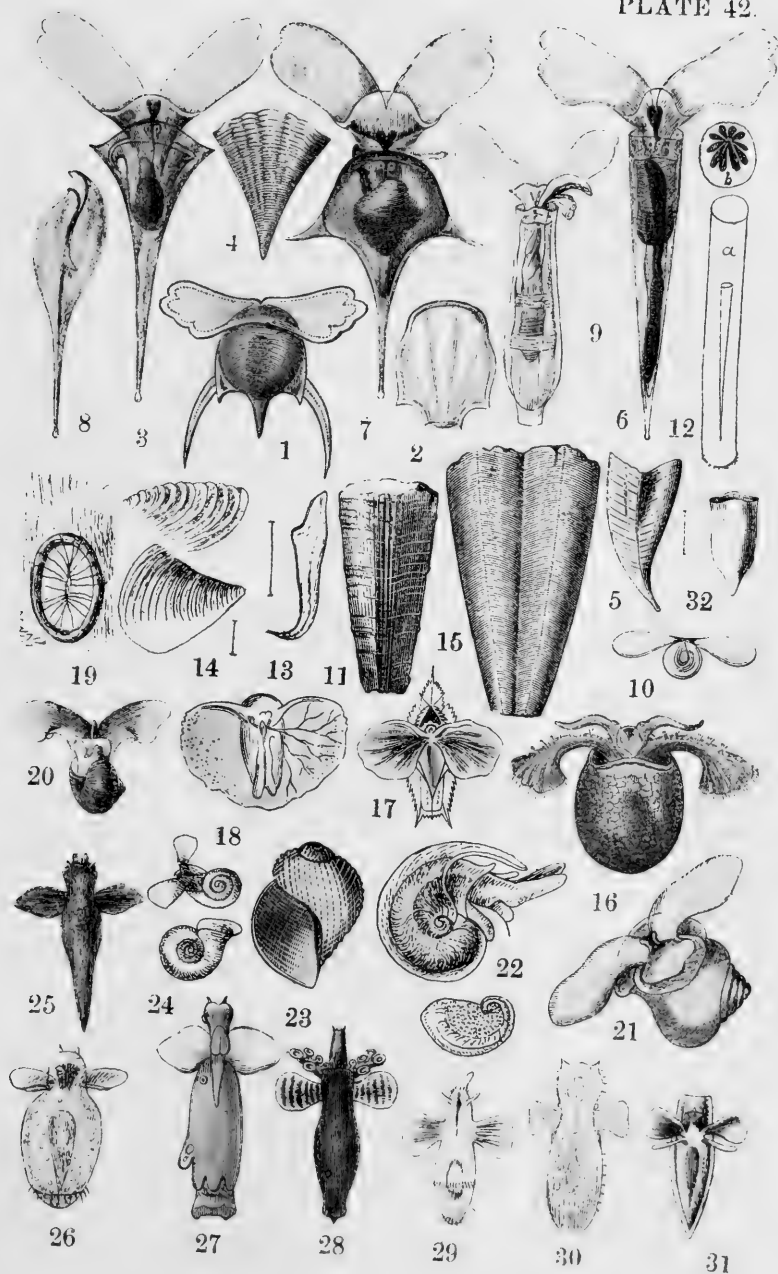
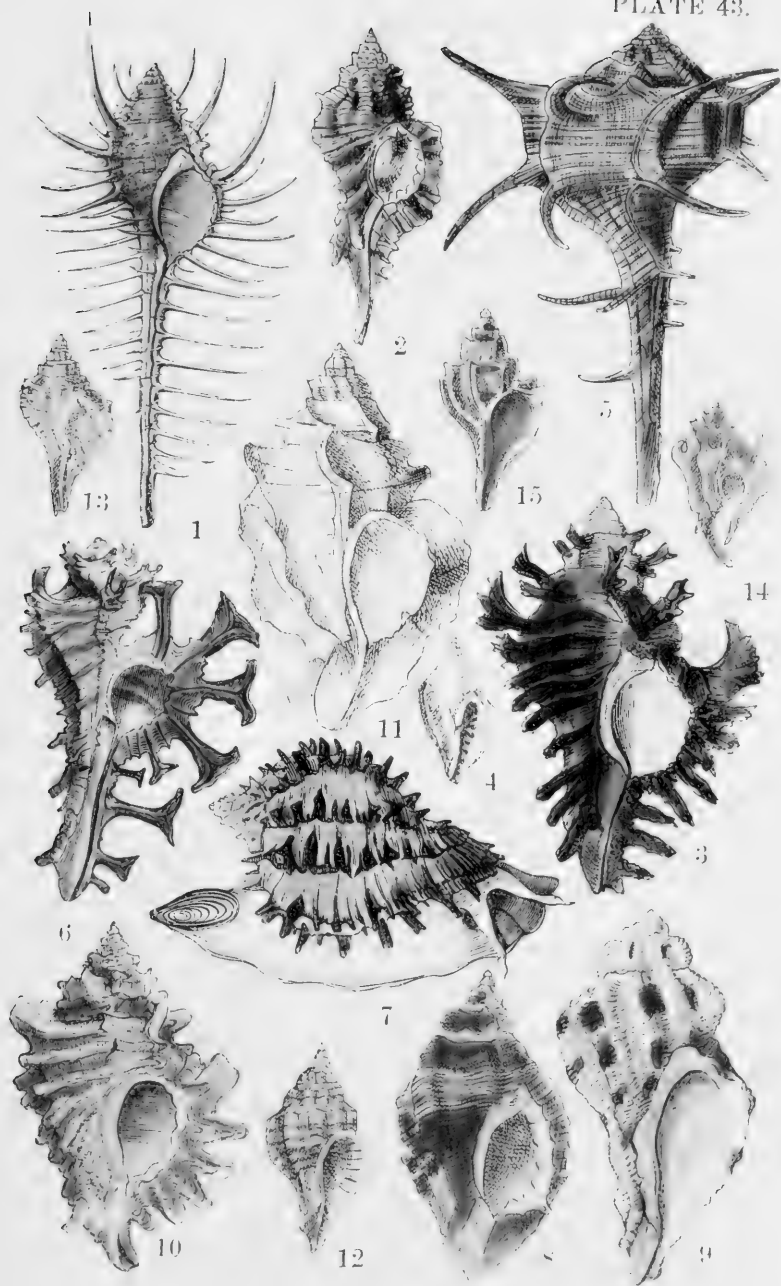
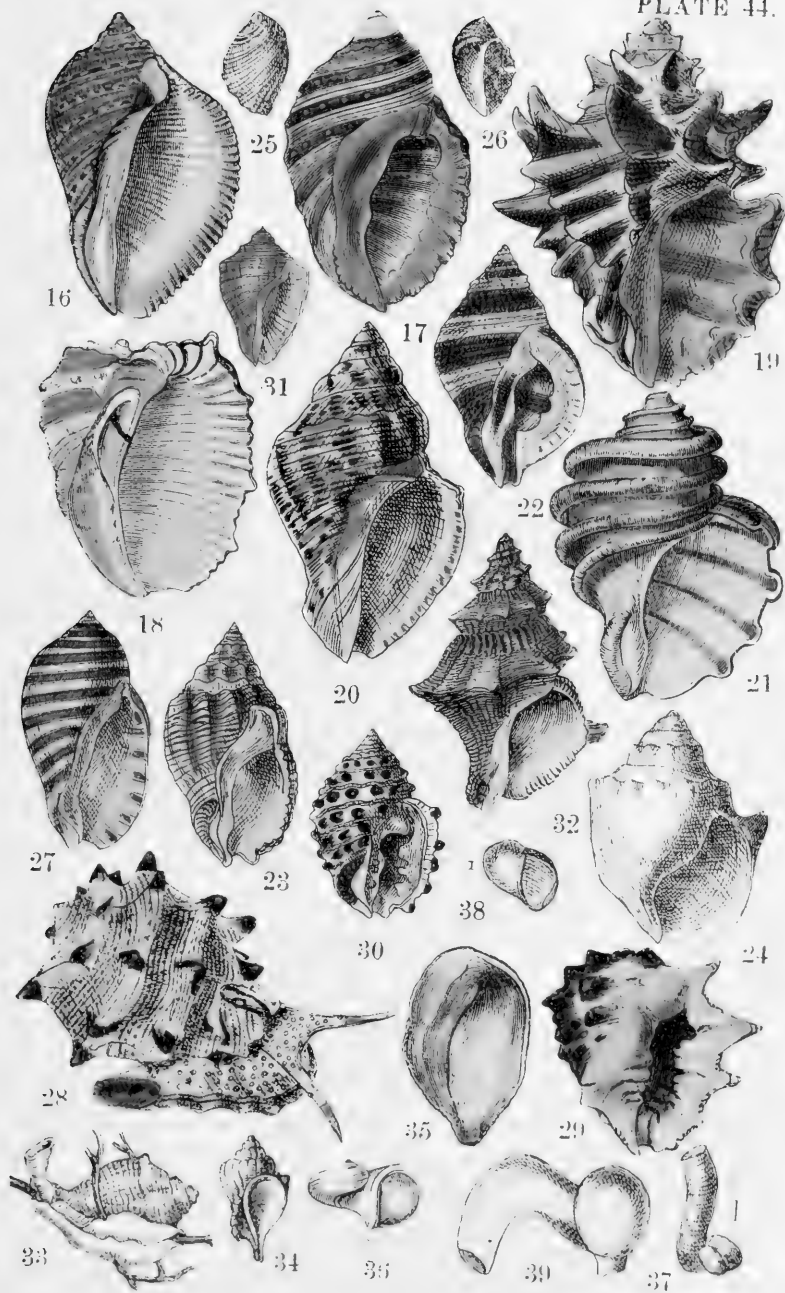
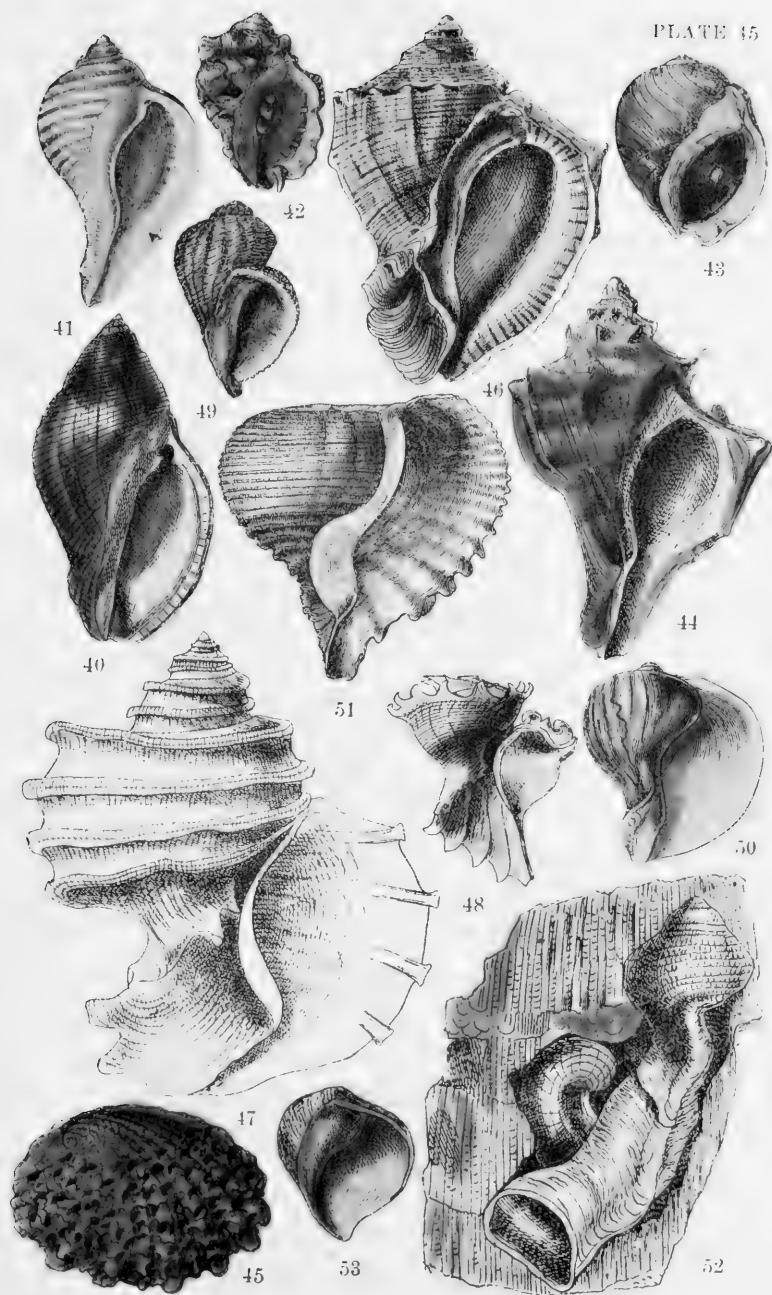




PLATE 43.







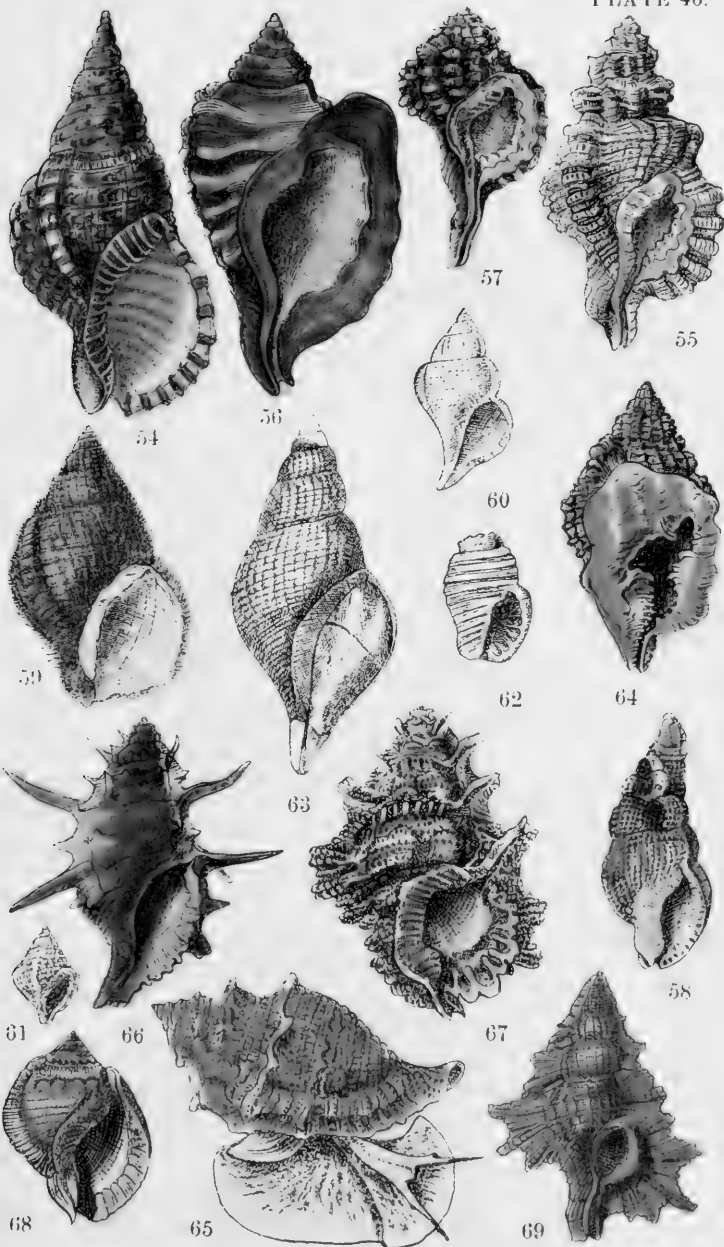
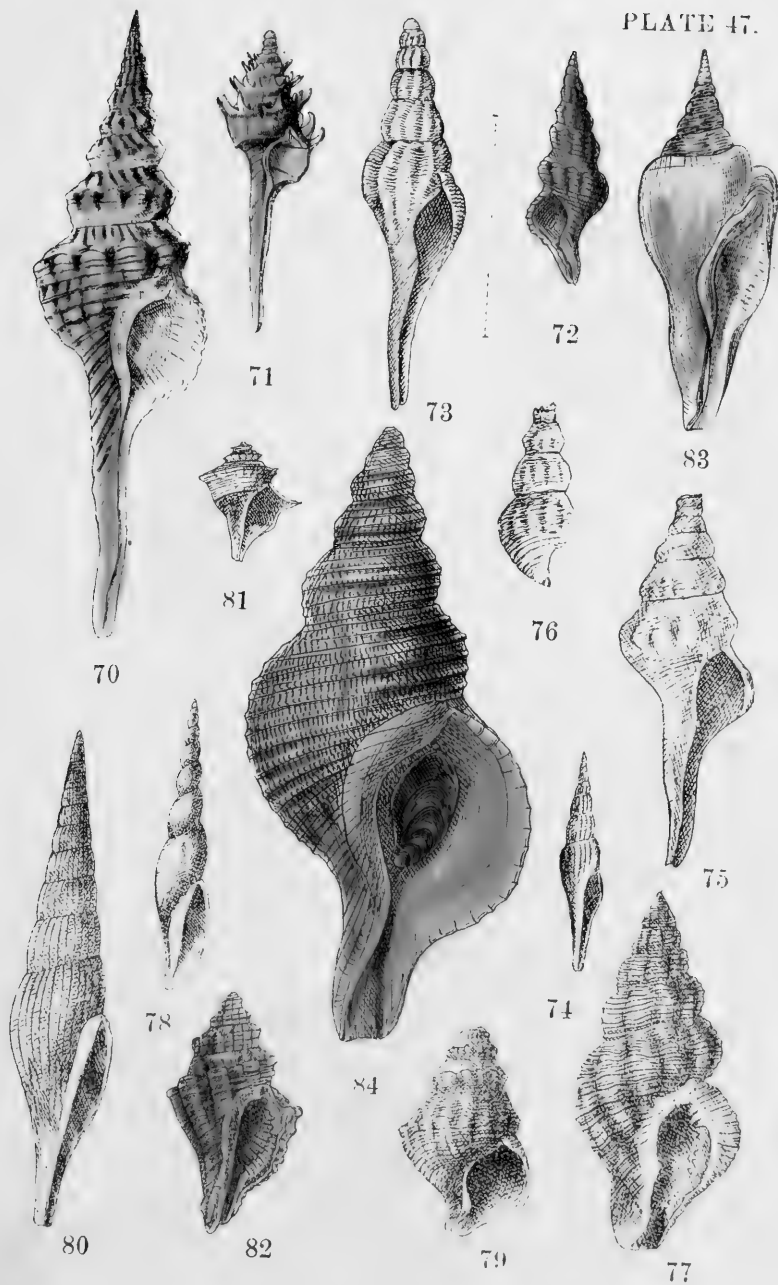
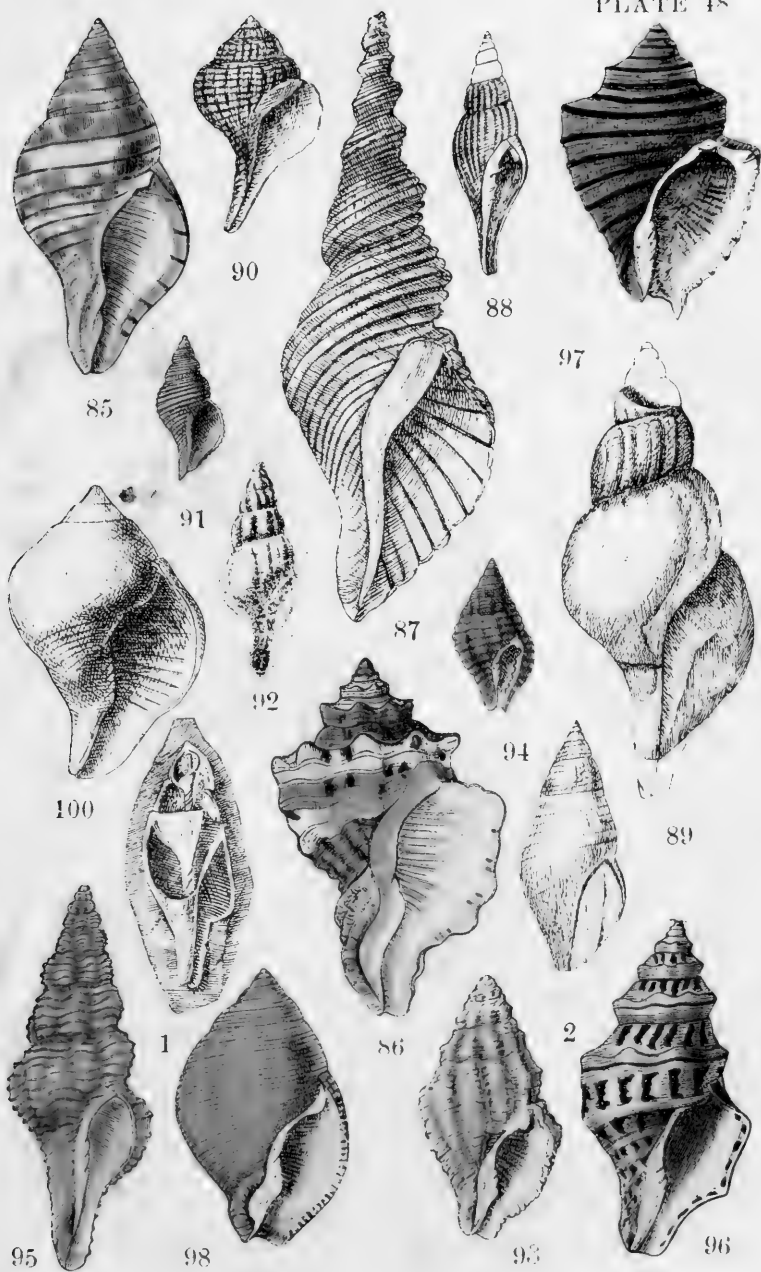


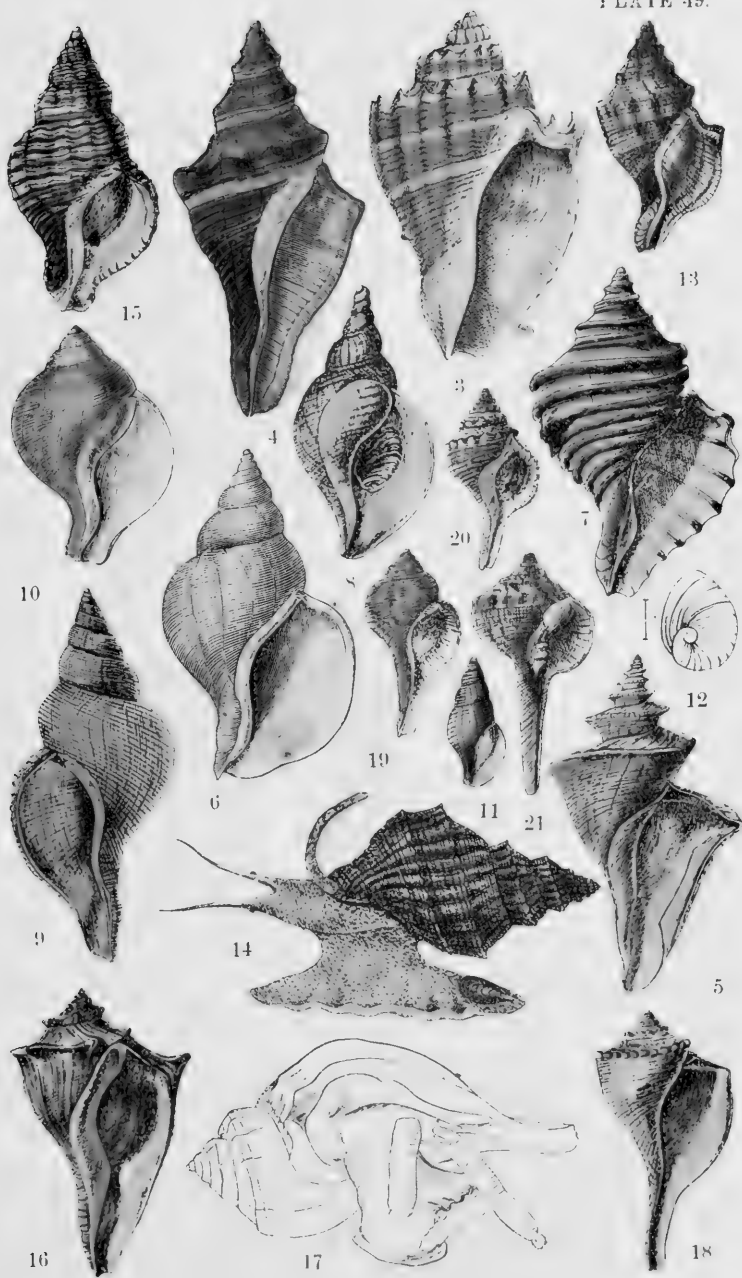
PLATE 47.



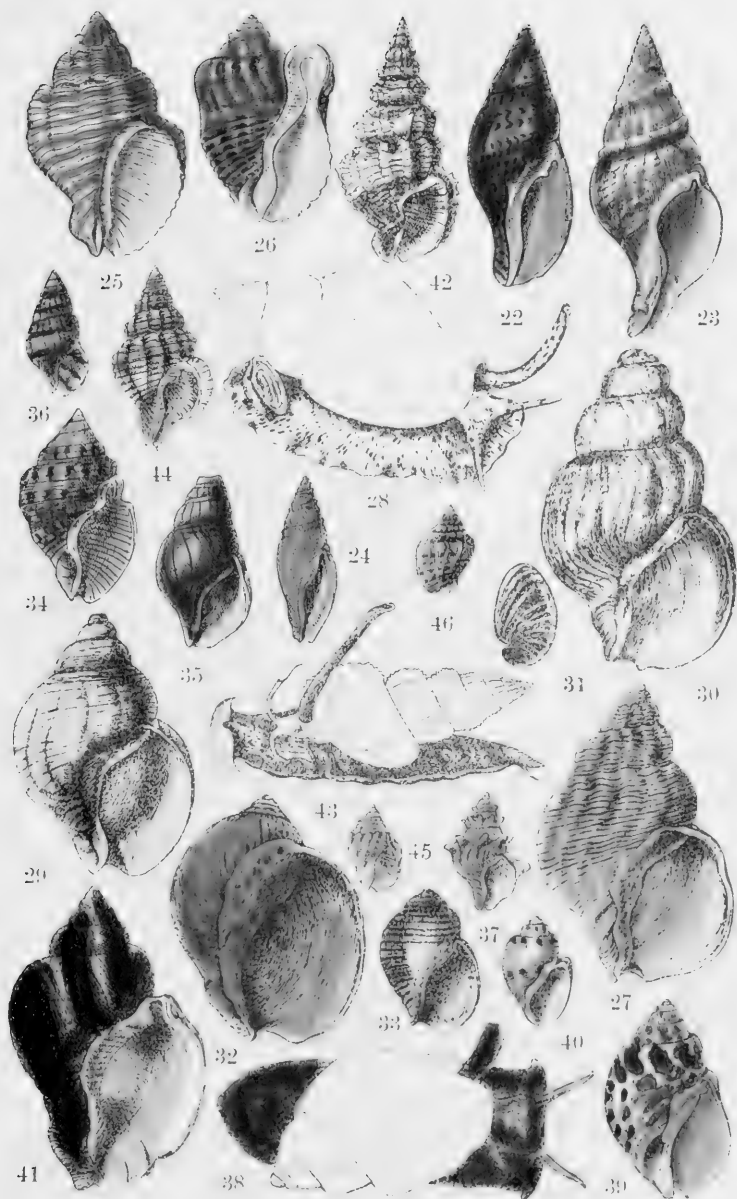




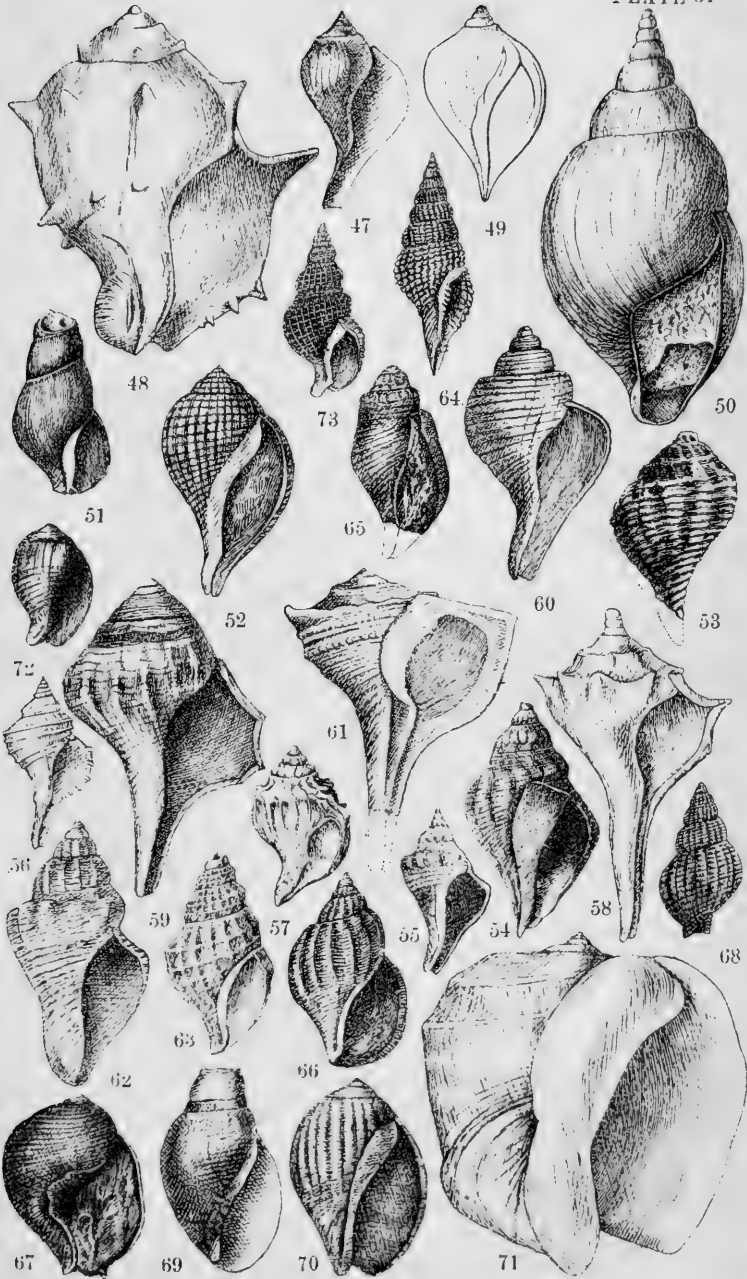


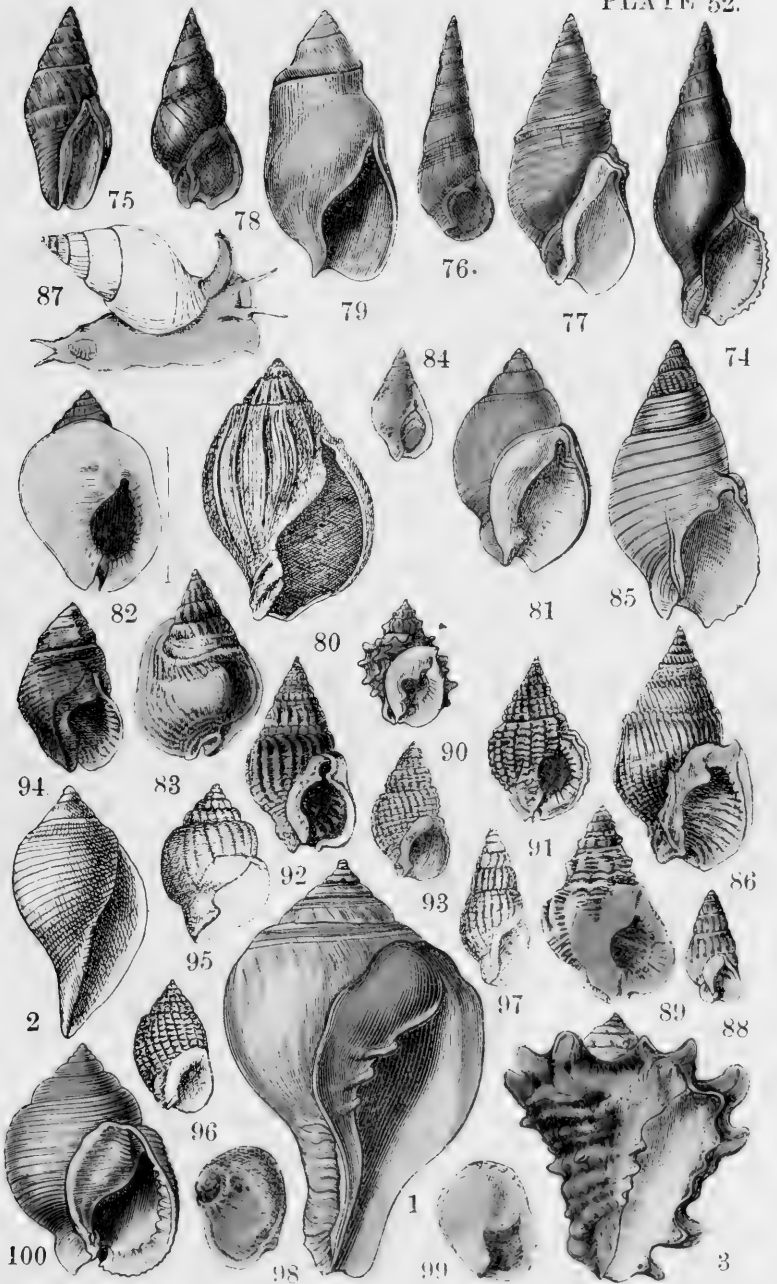


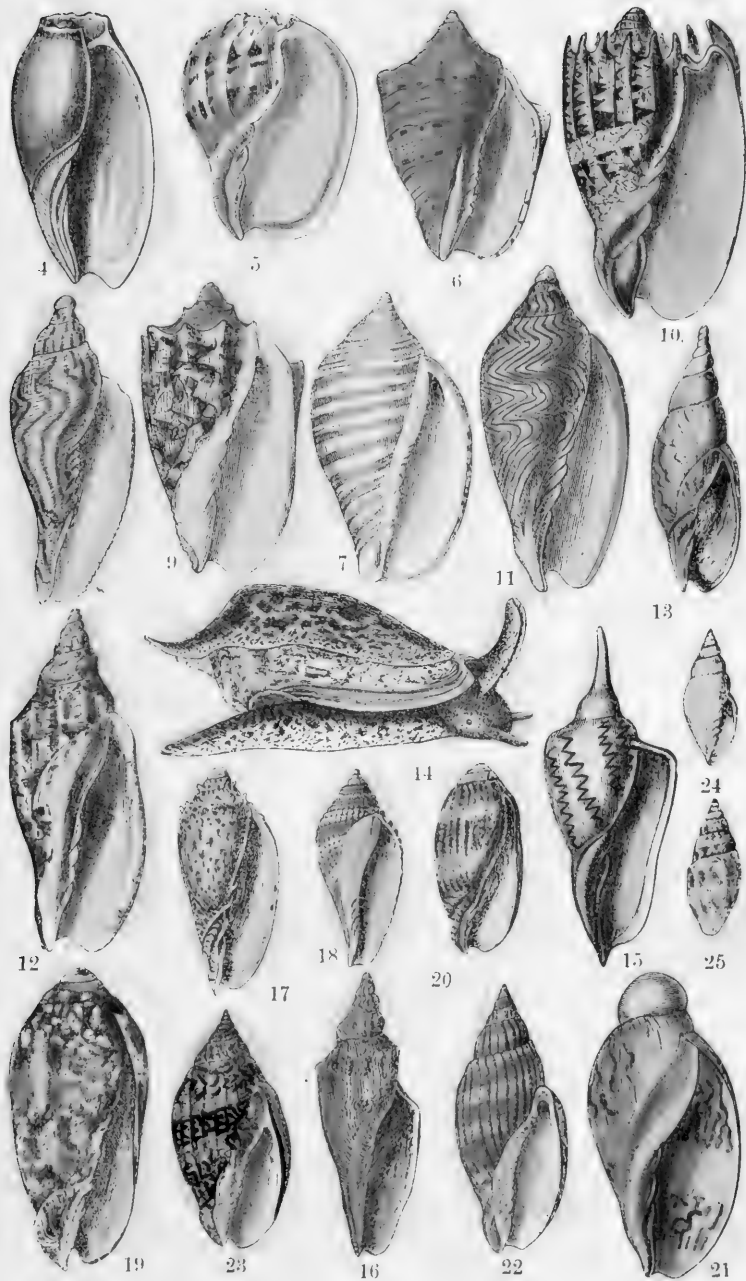


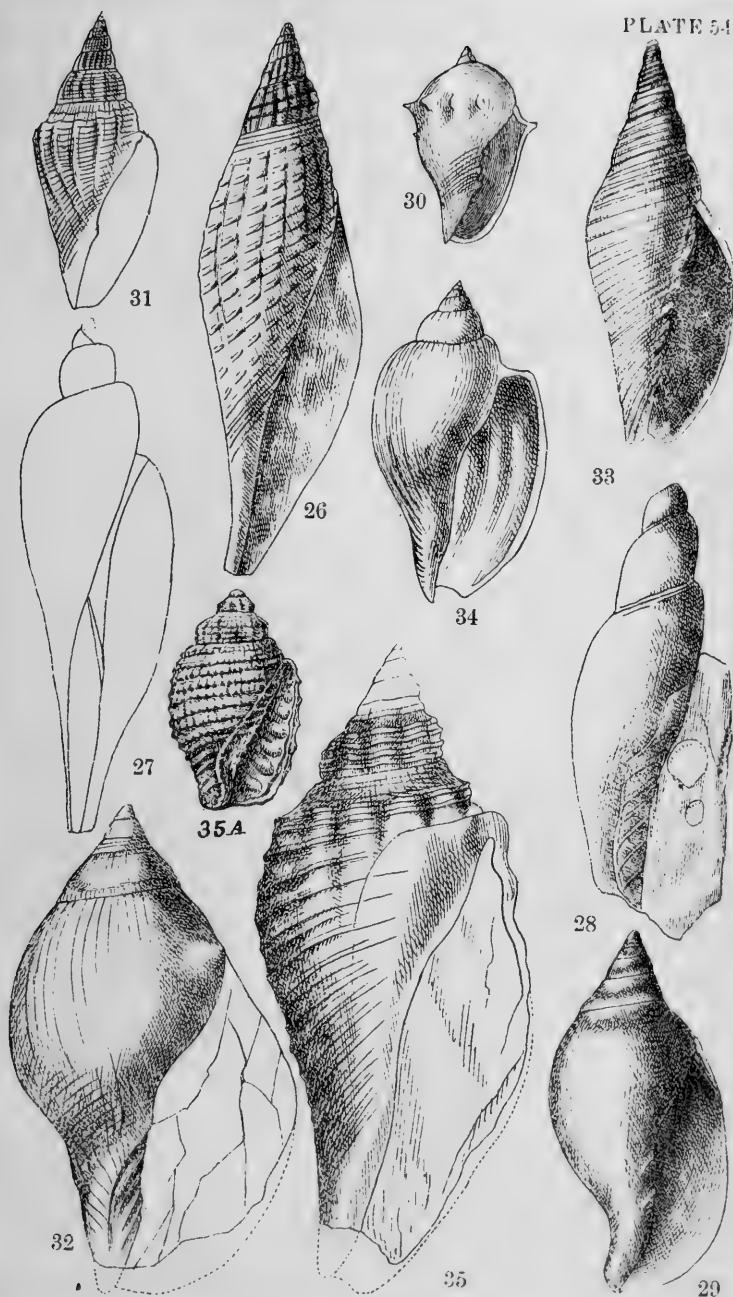


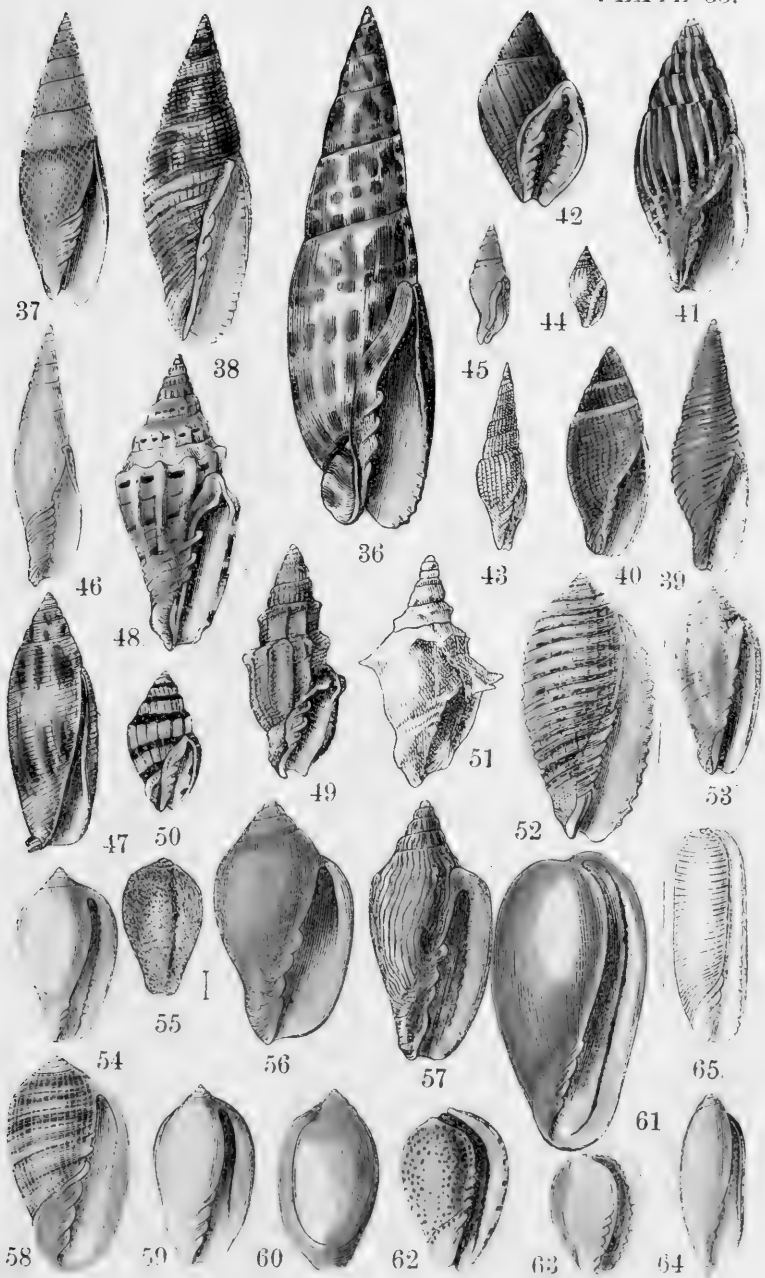




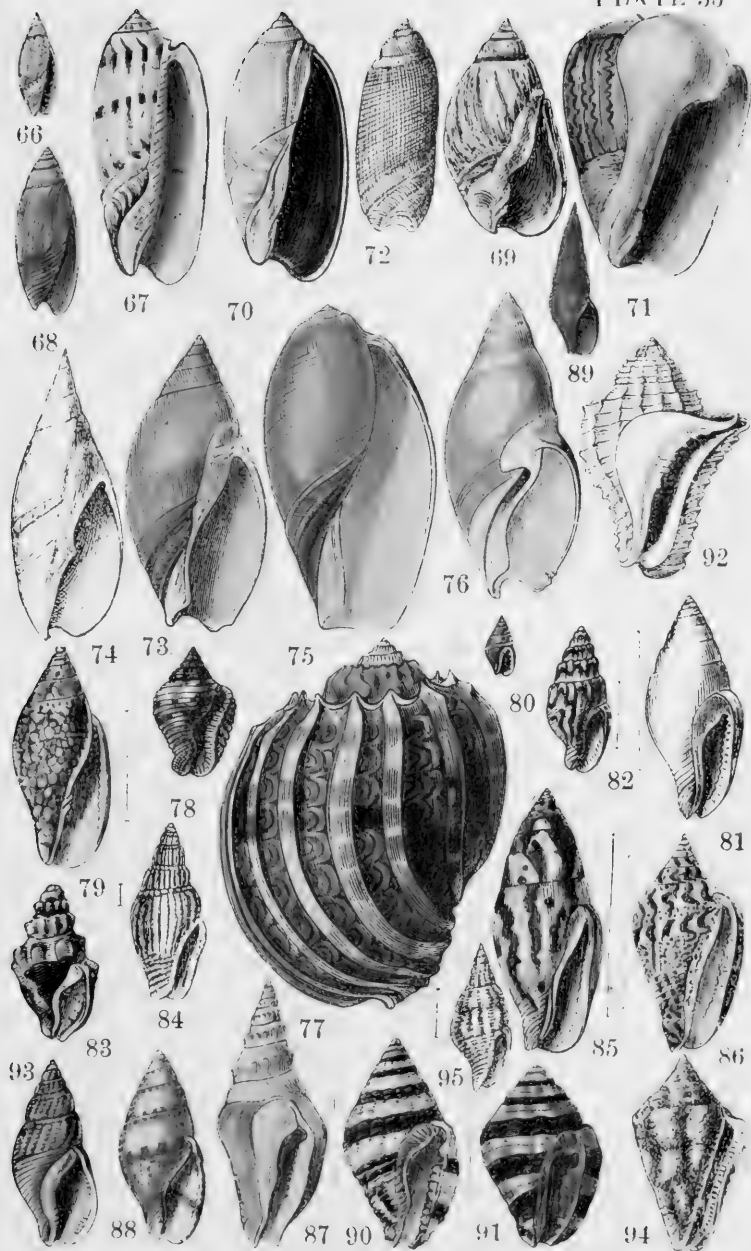


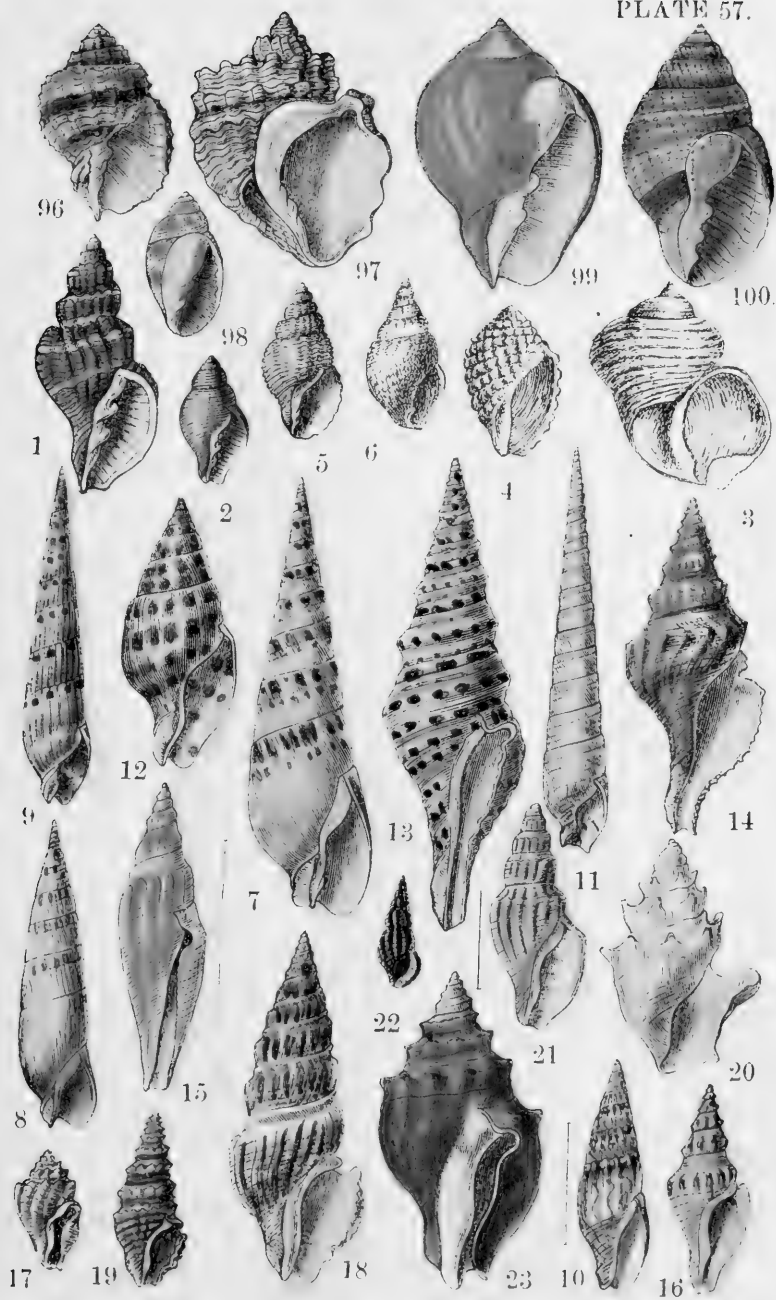




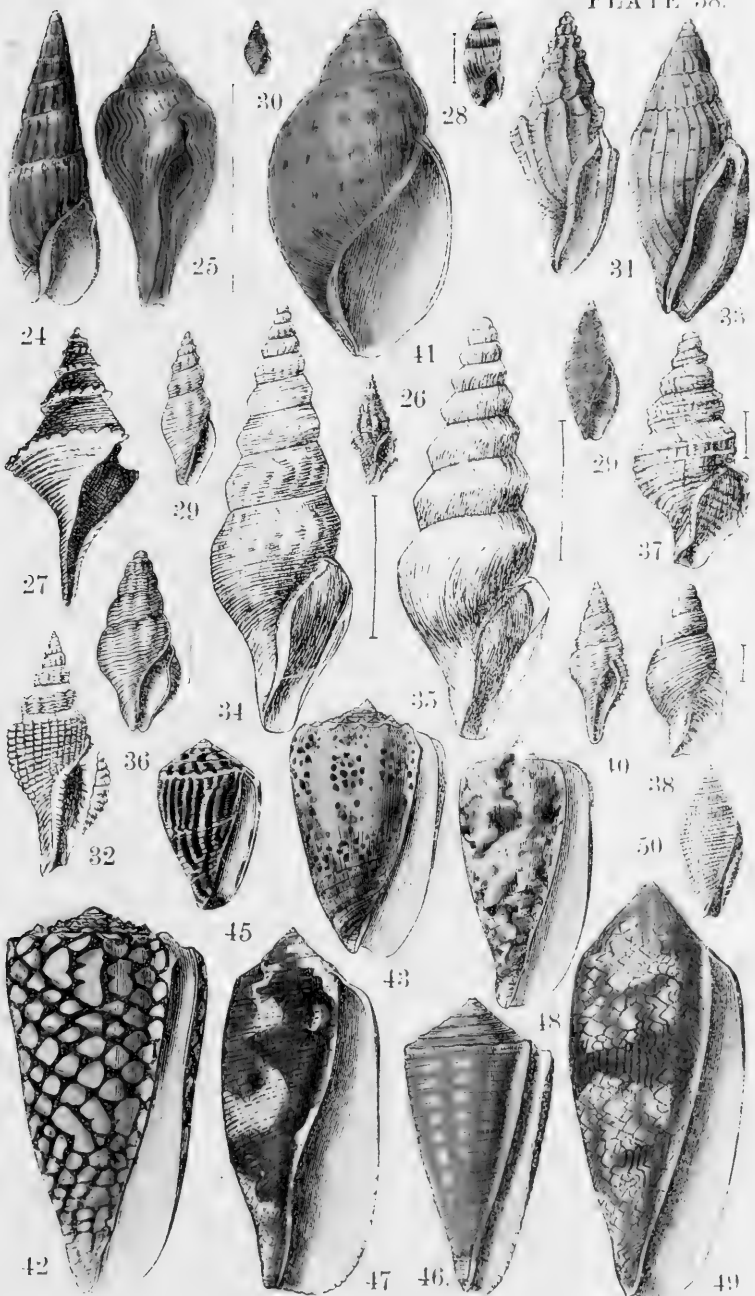


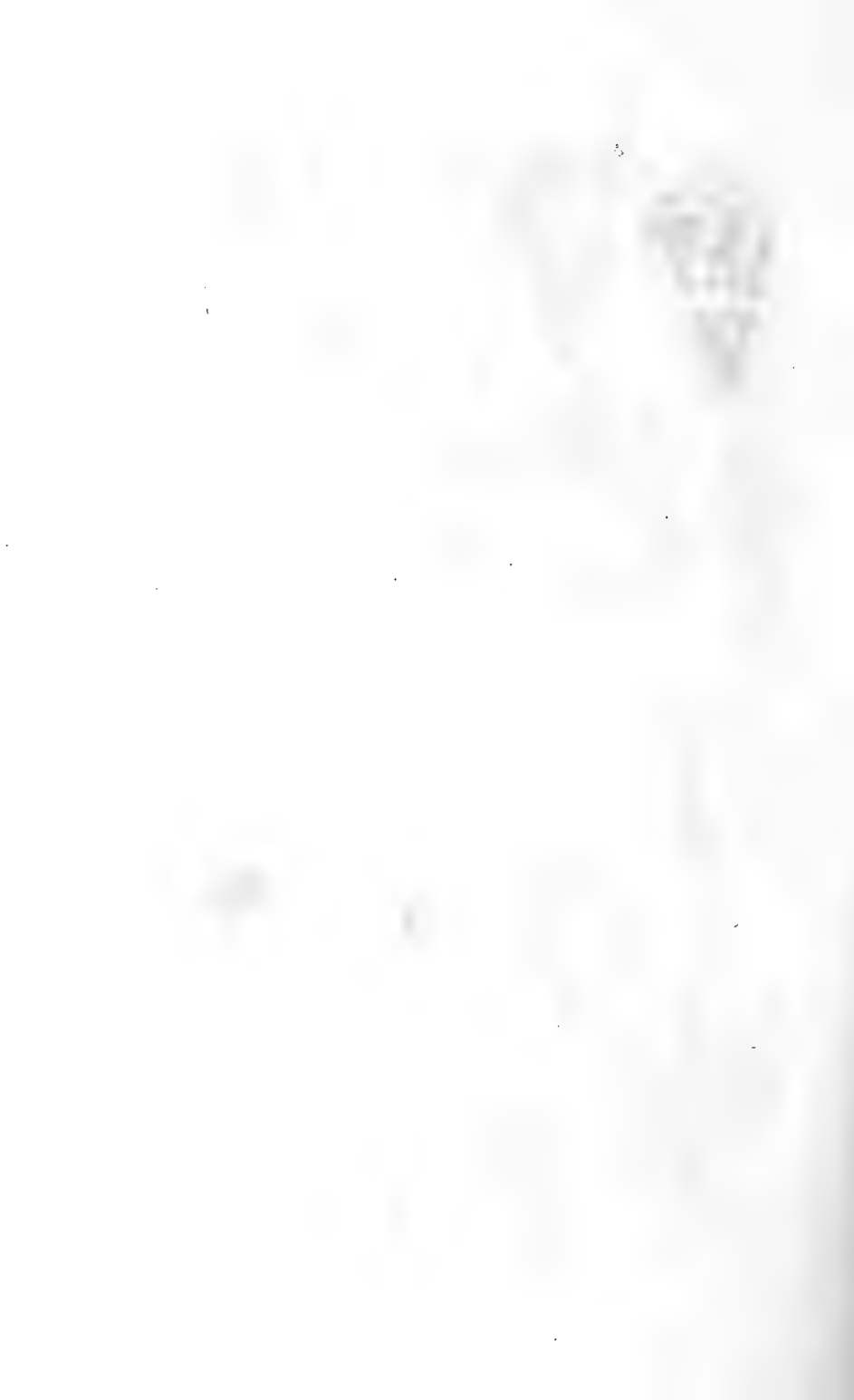


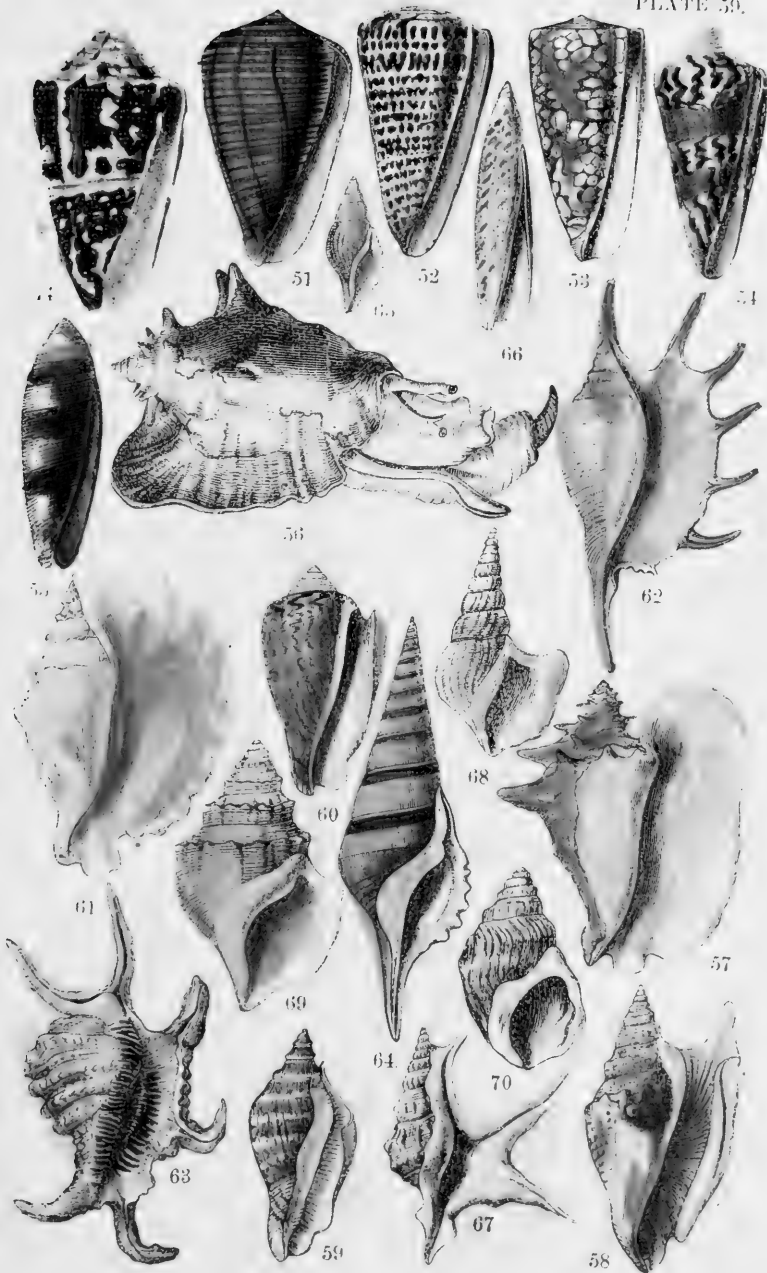














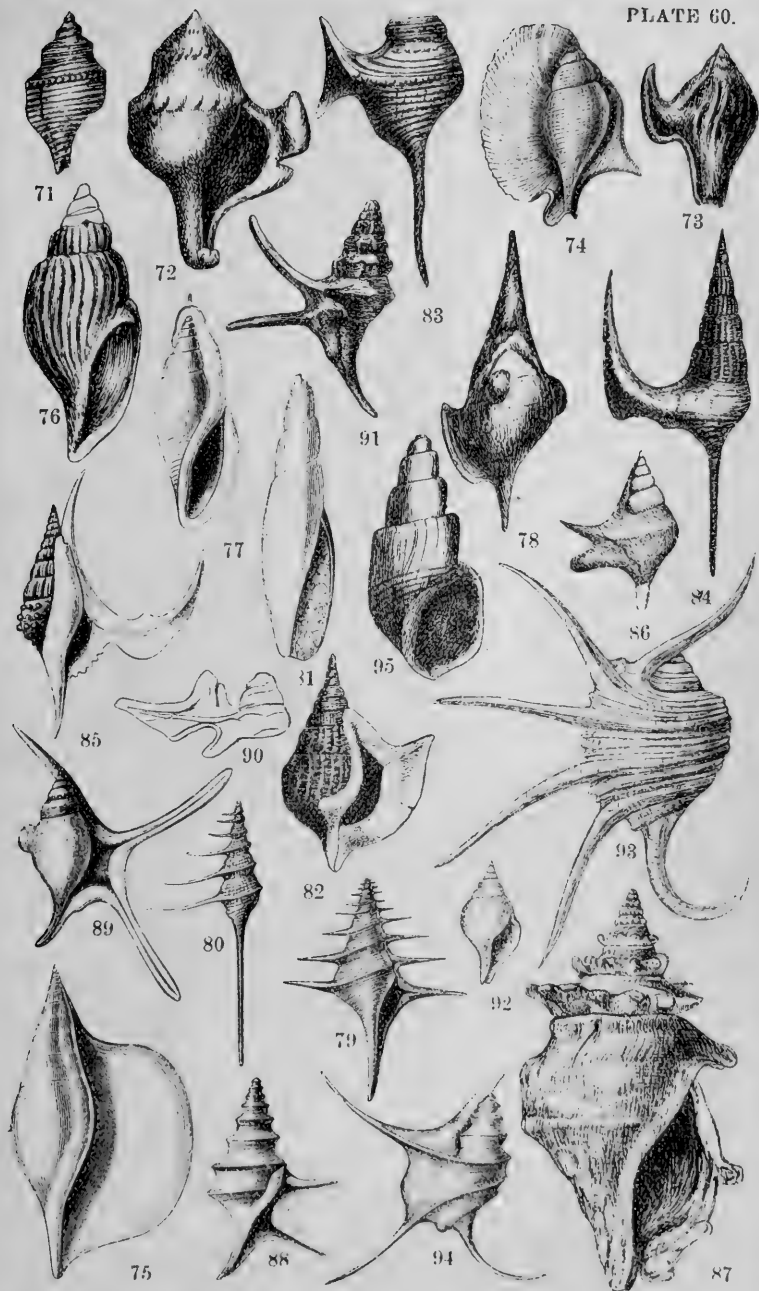
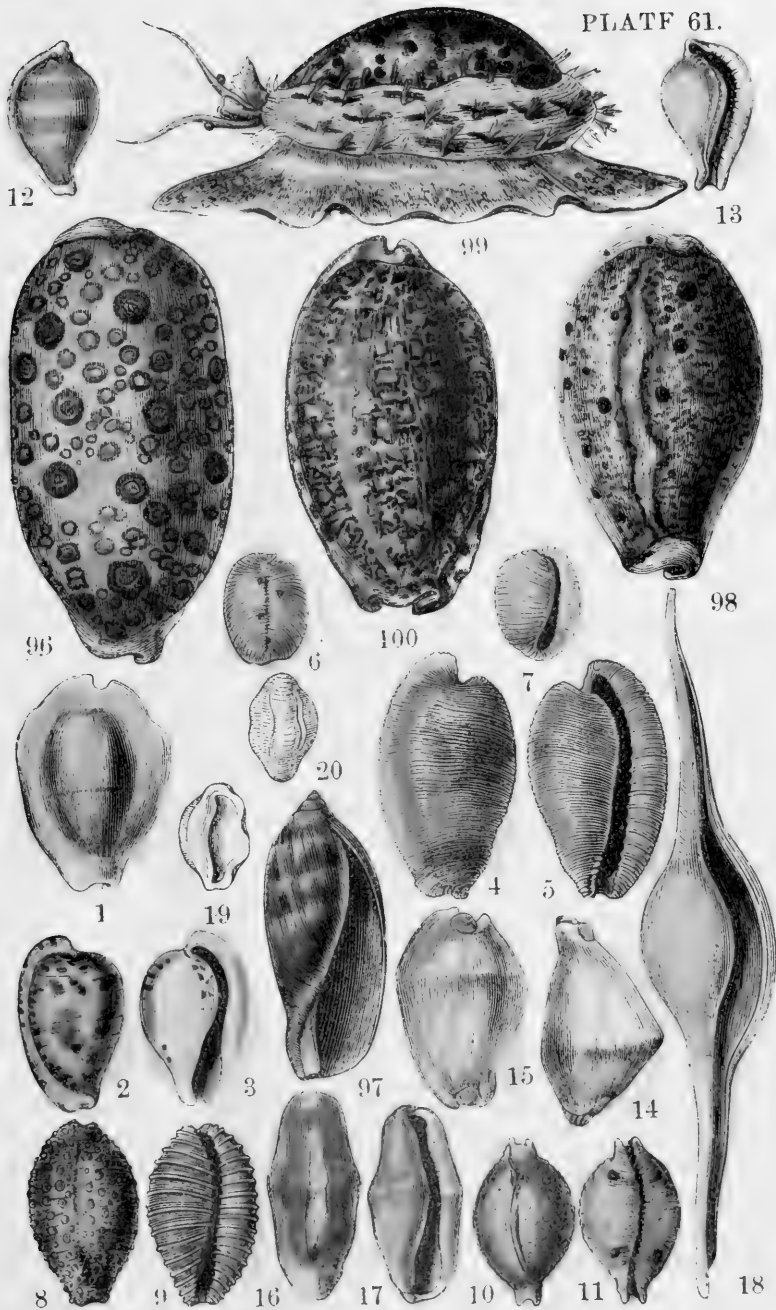
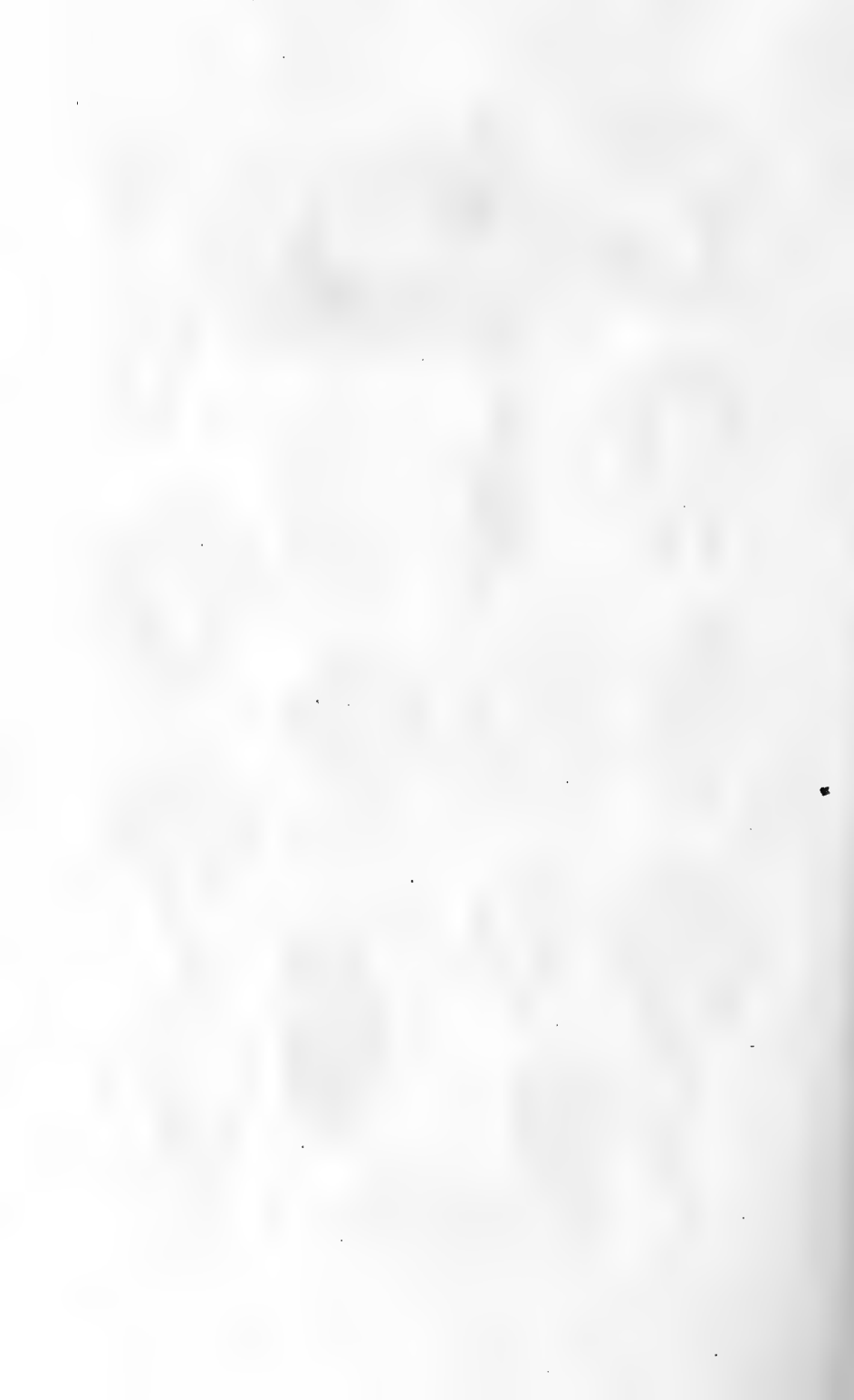
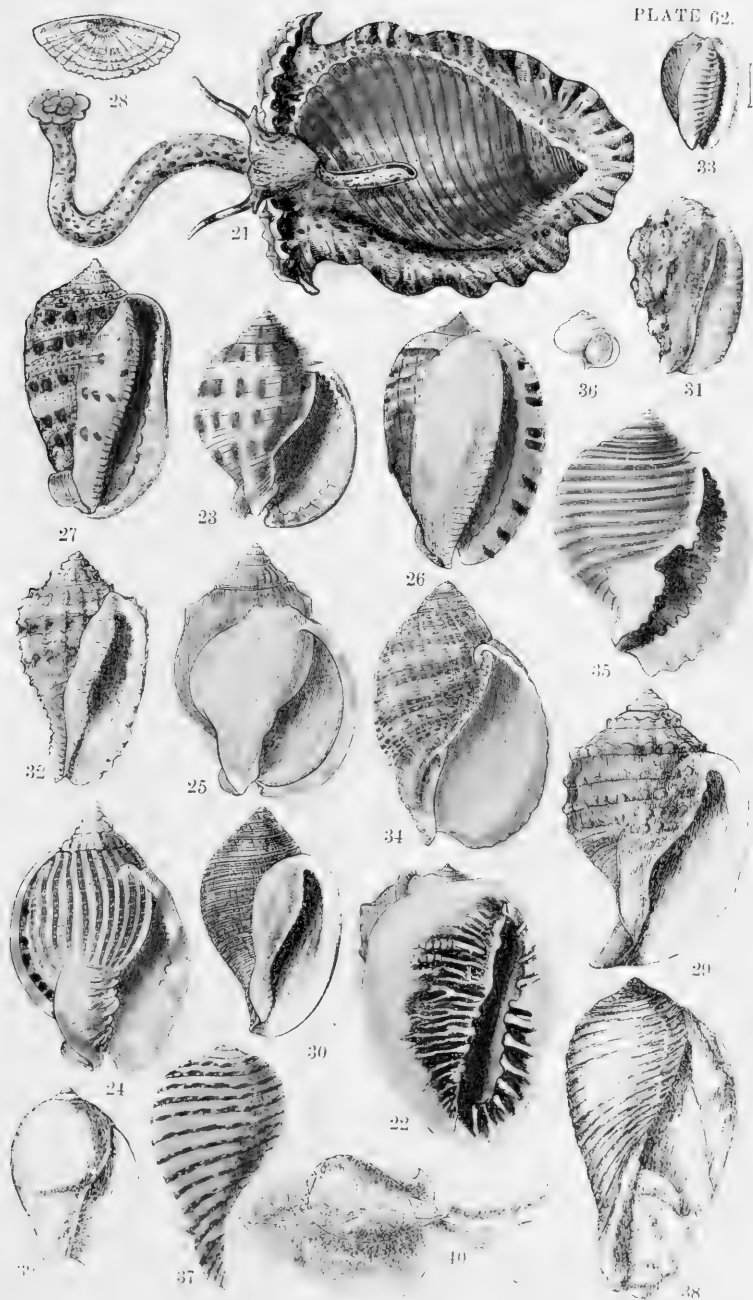


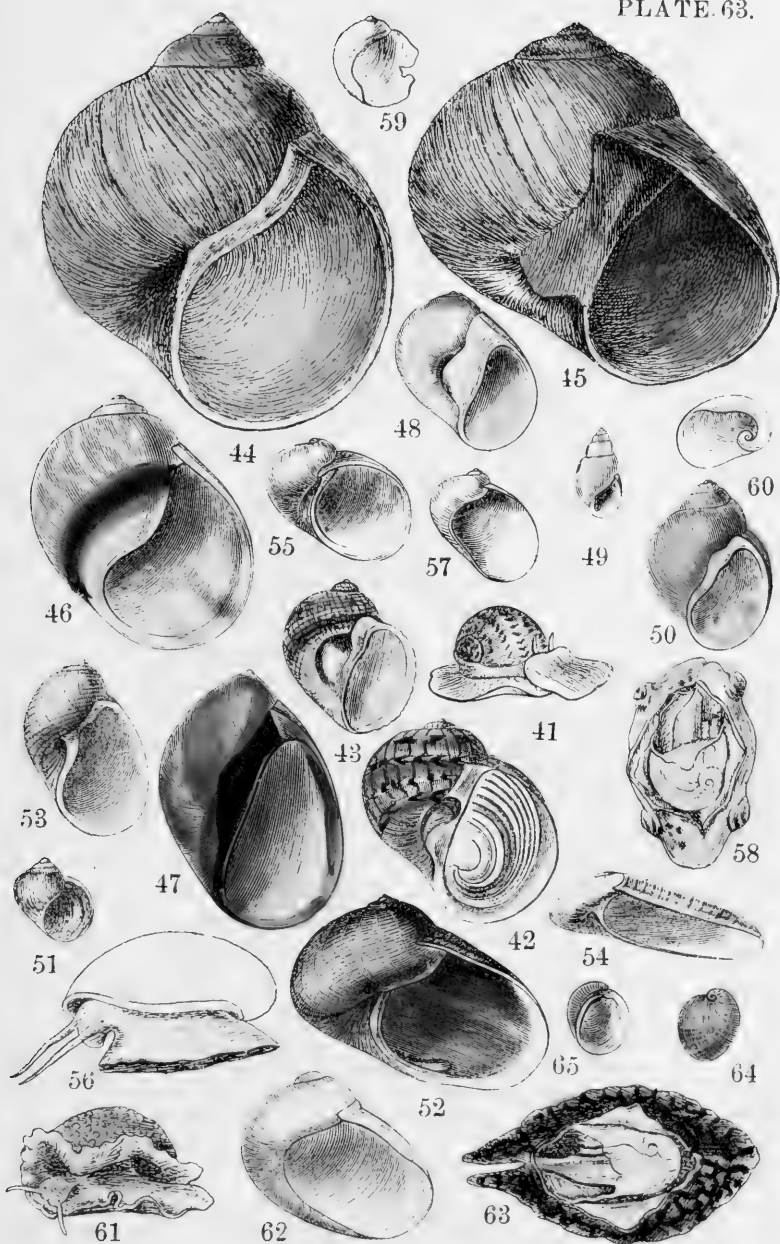
PLATE 61.











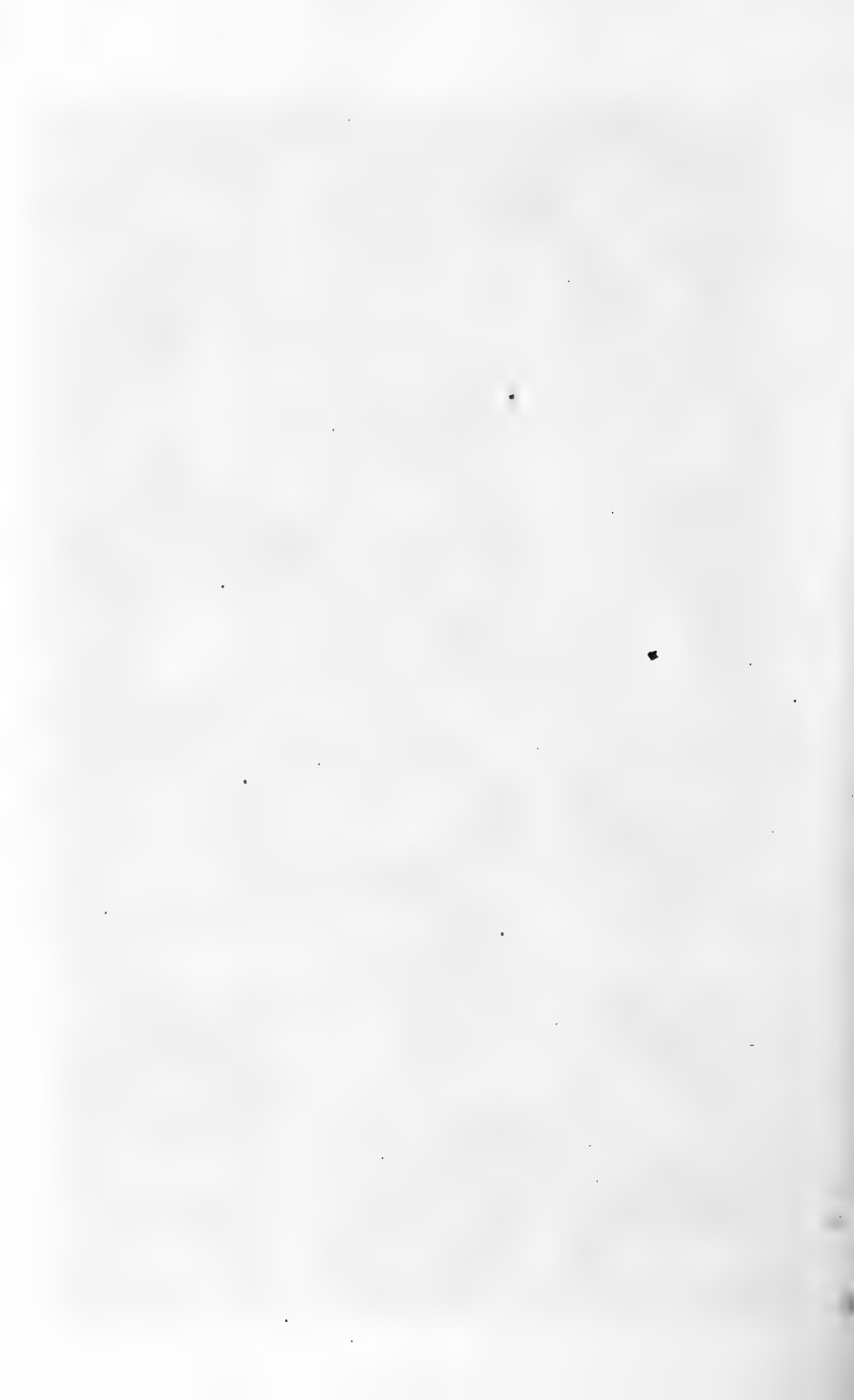
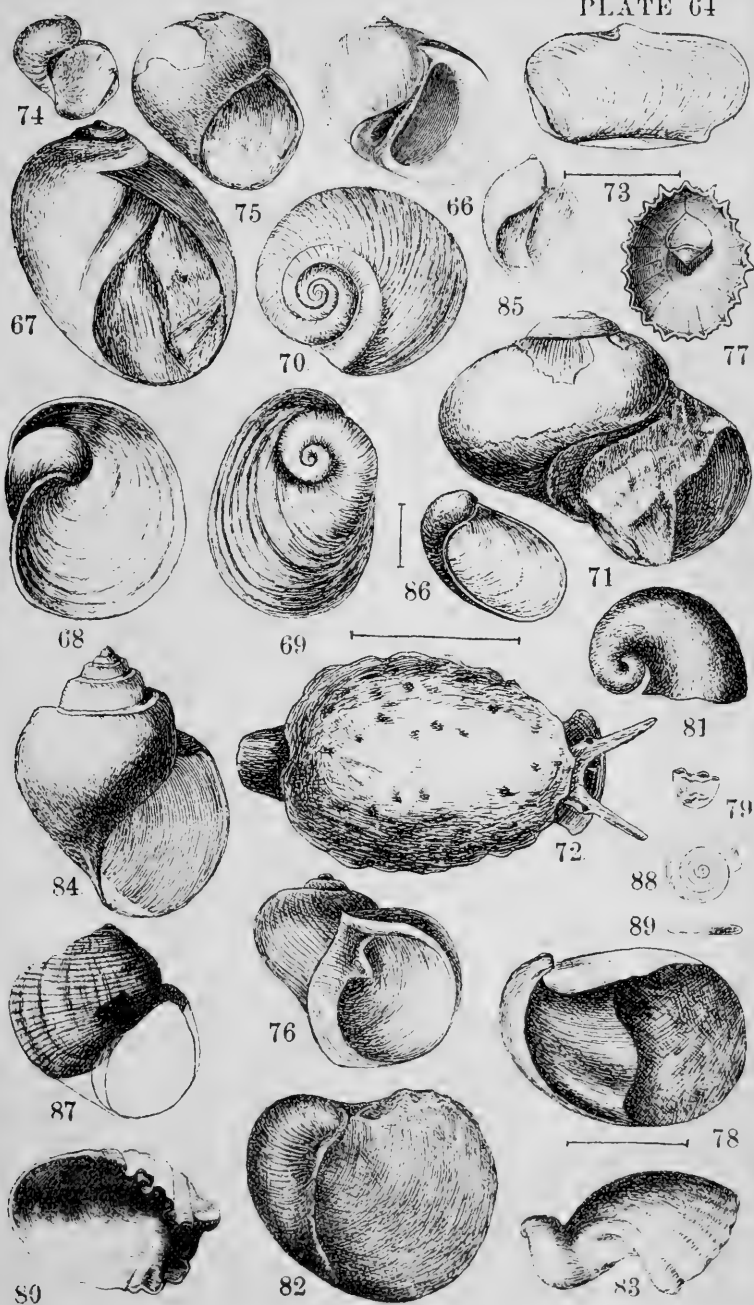
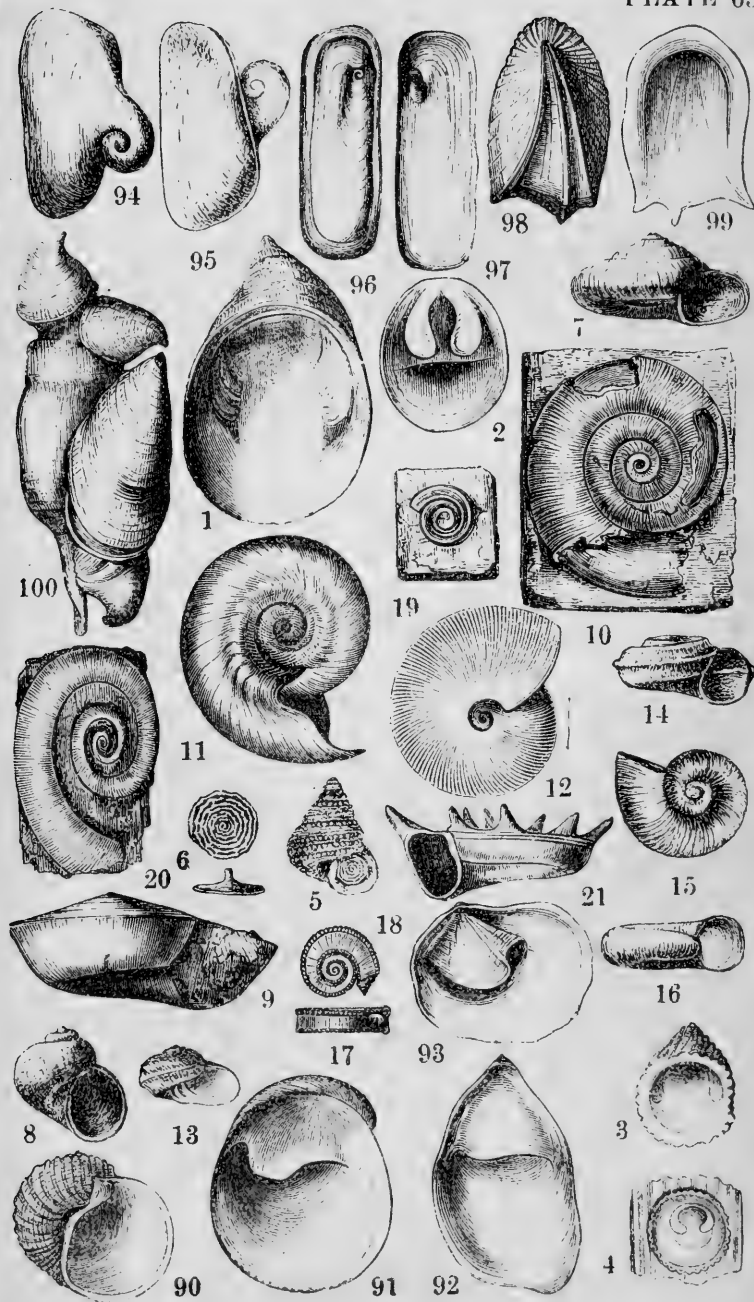


PLATE 64







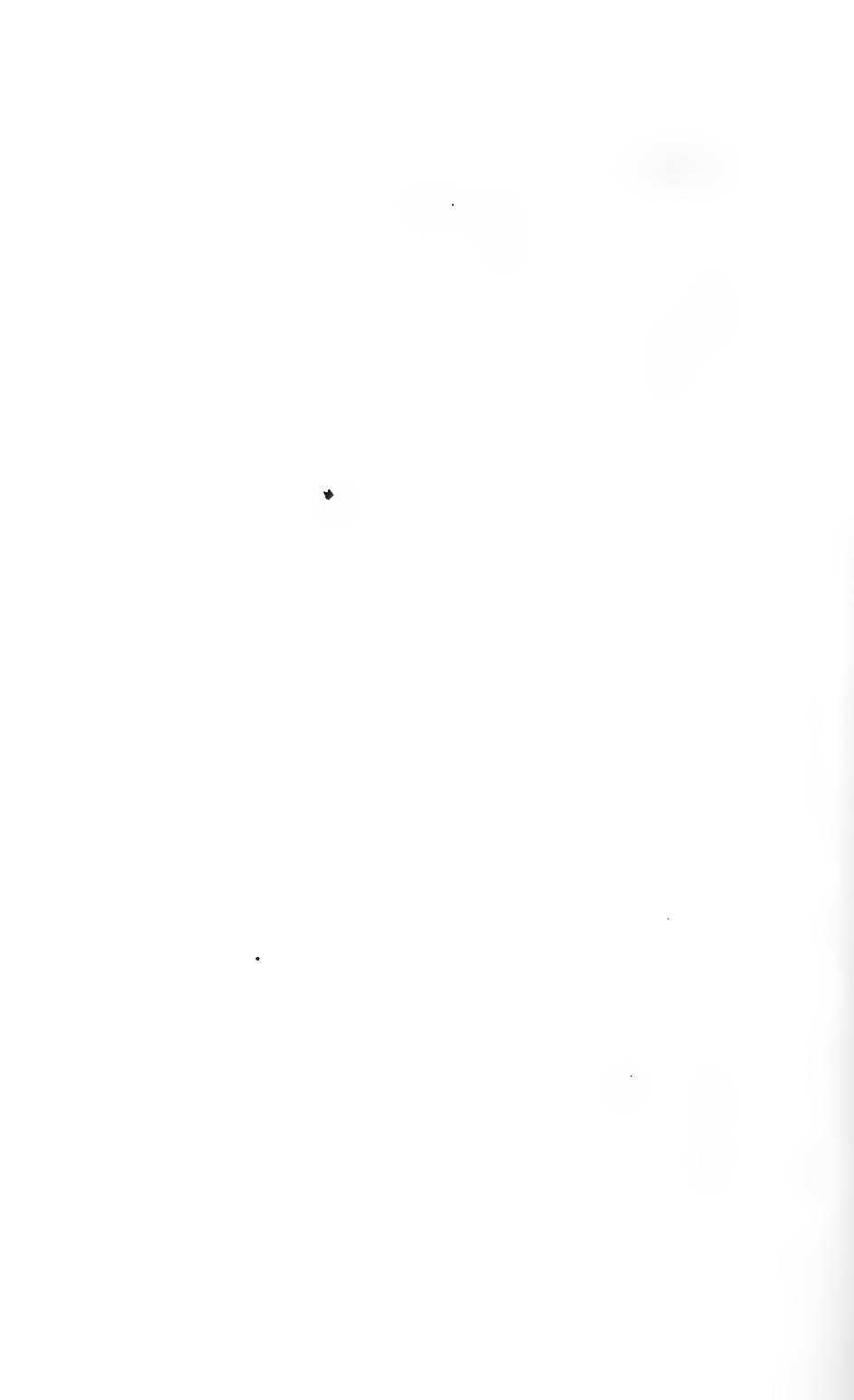
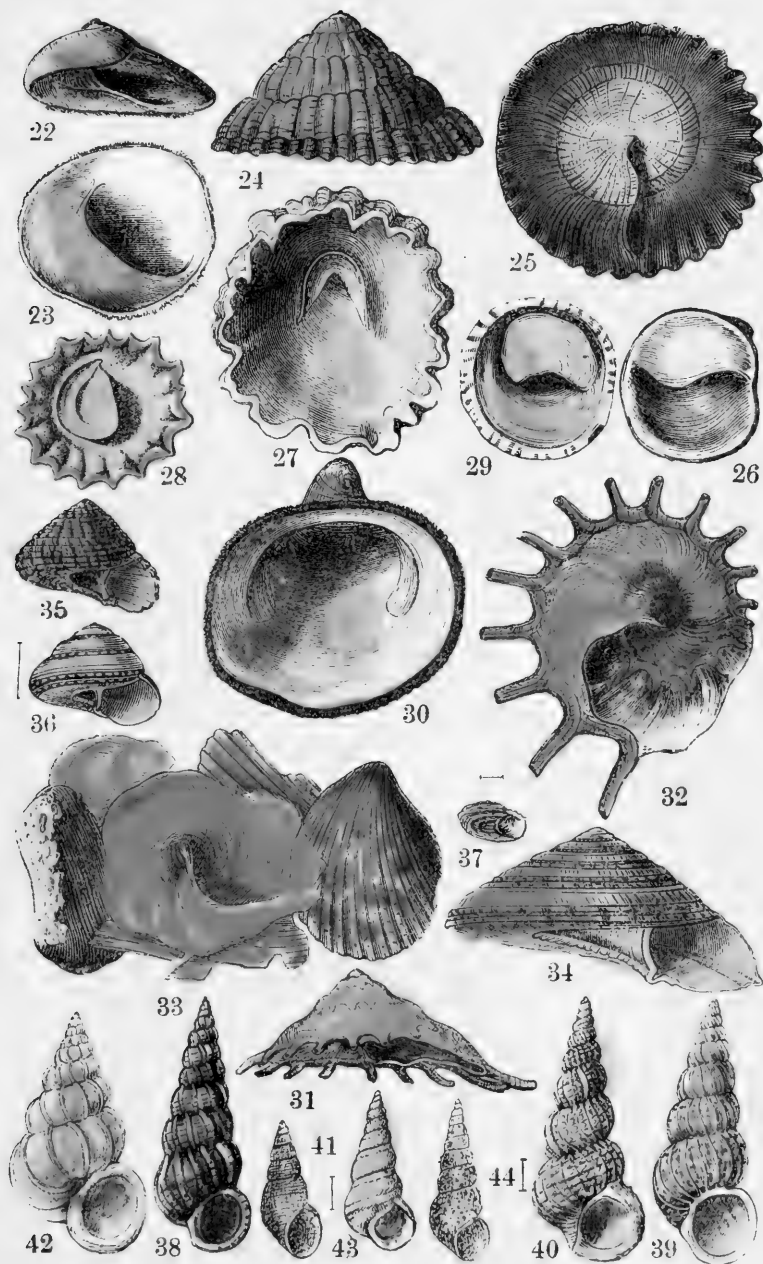
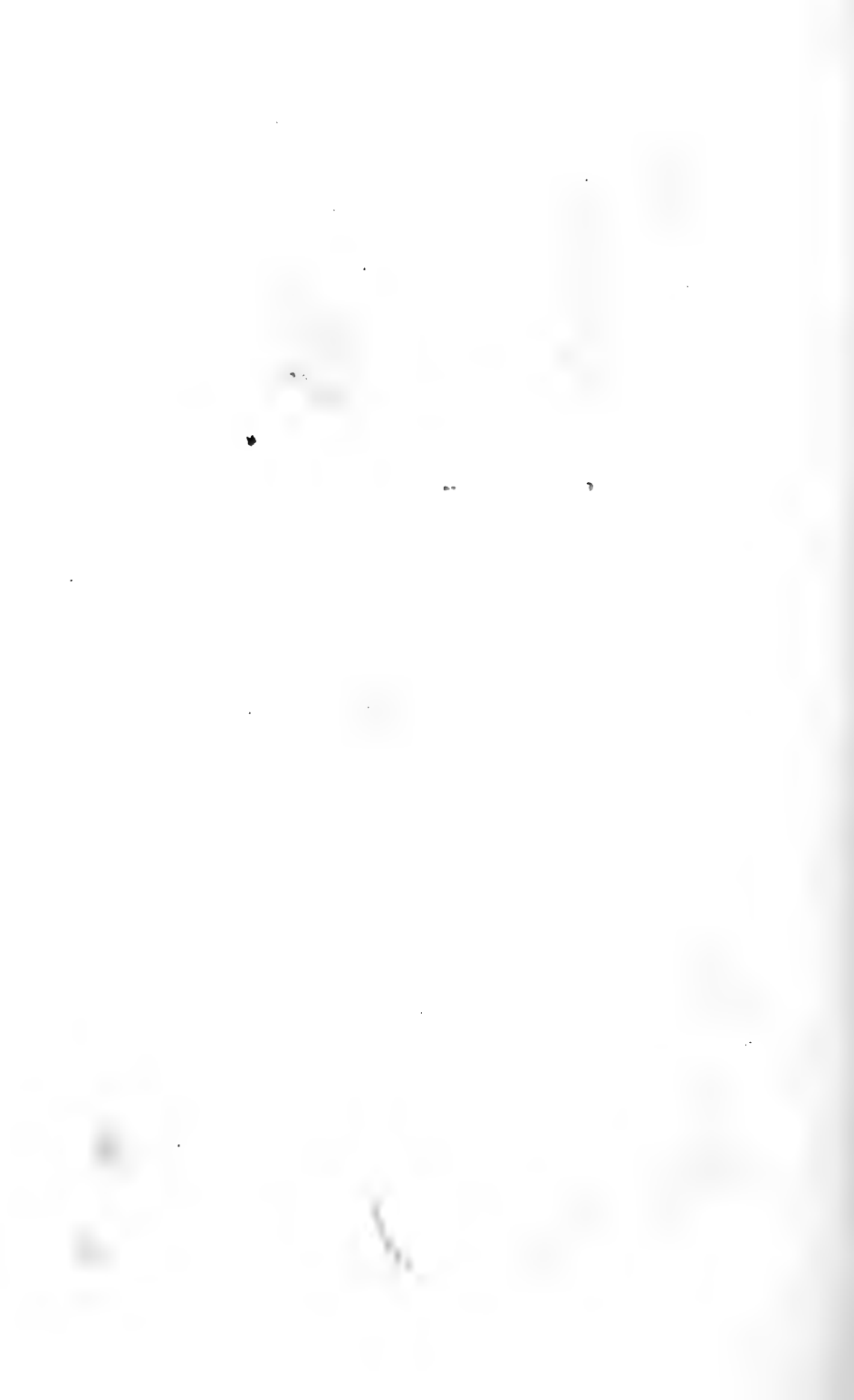
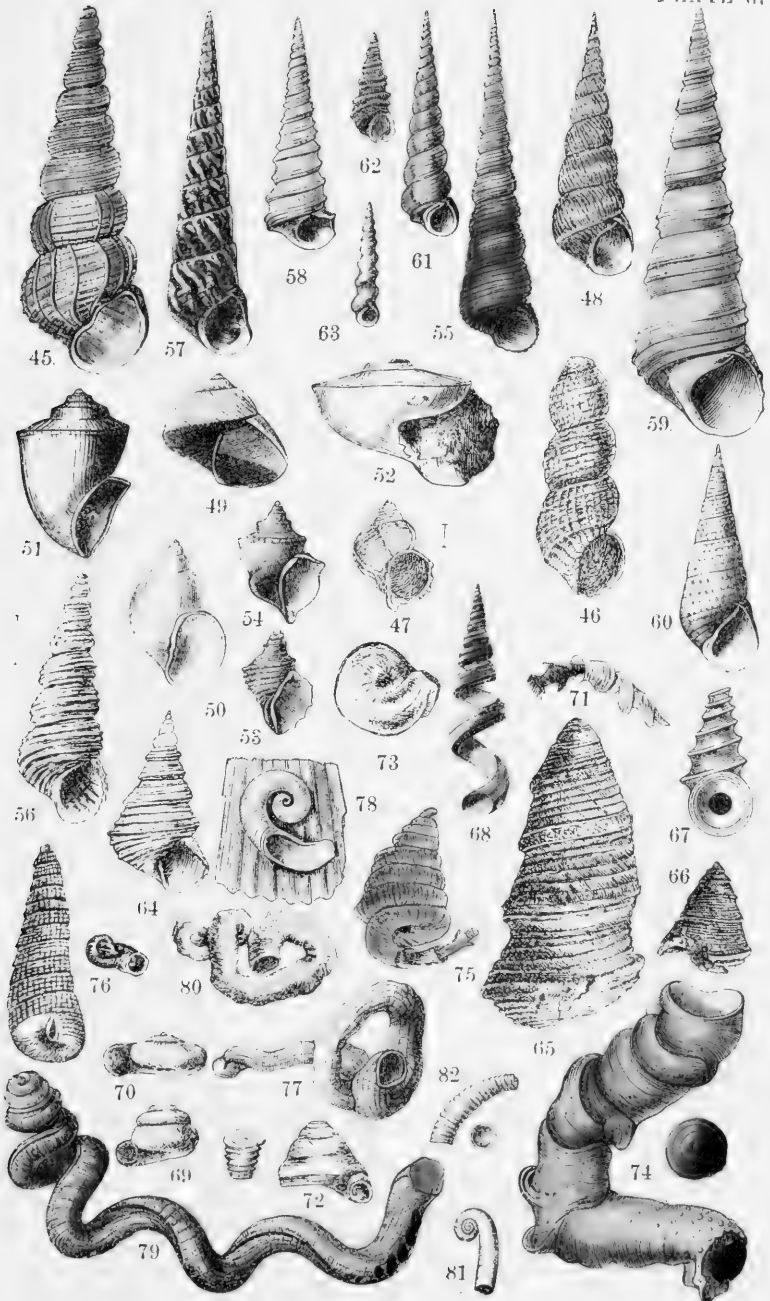
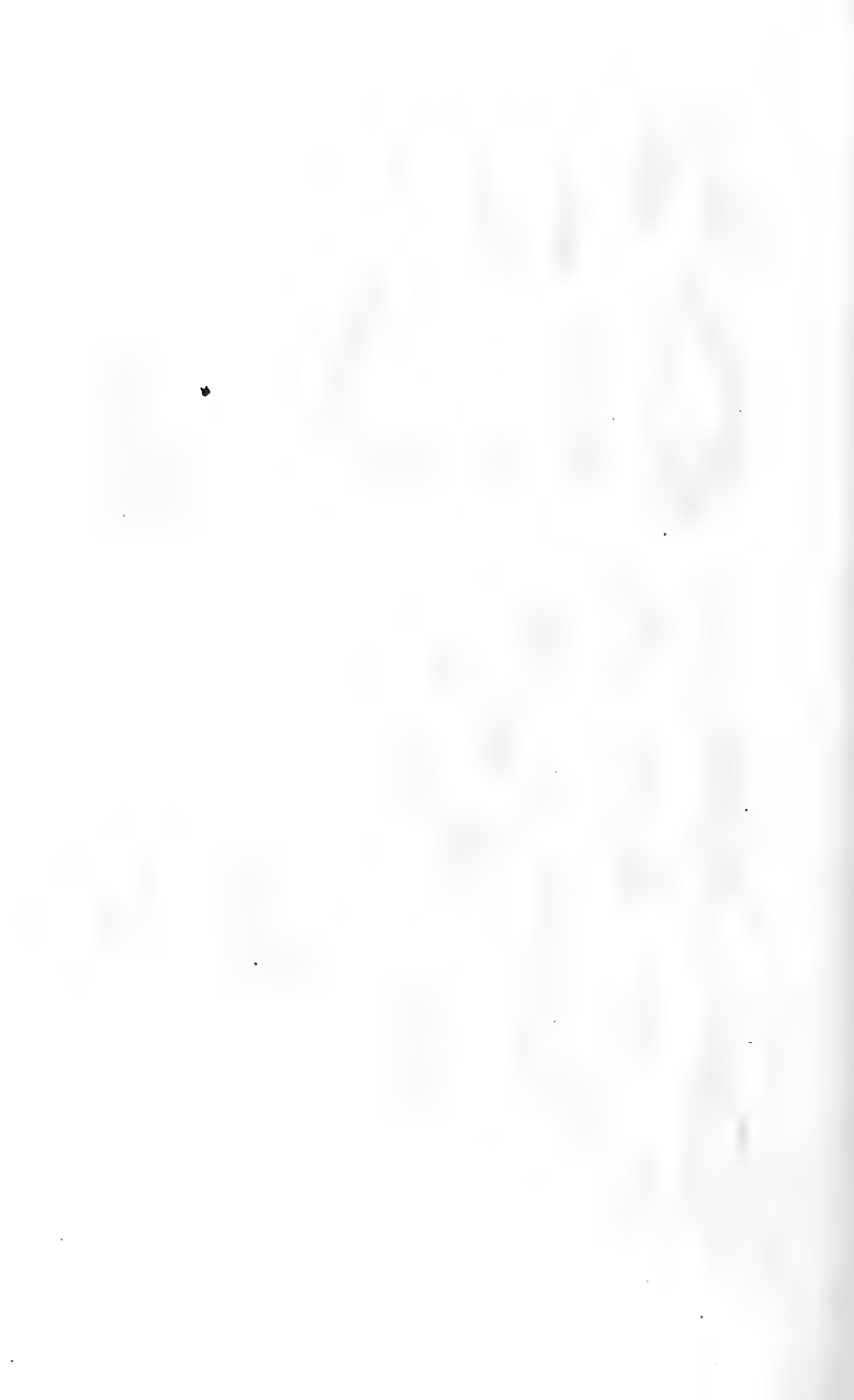


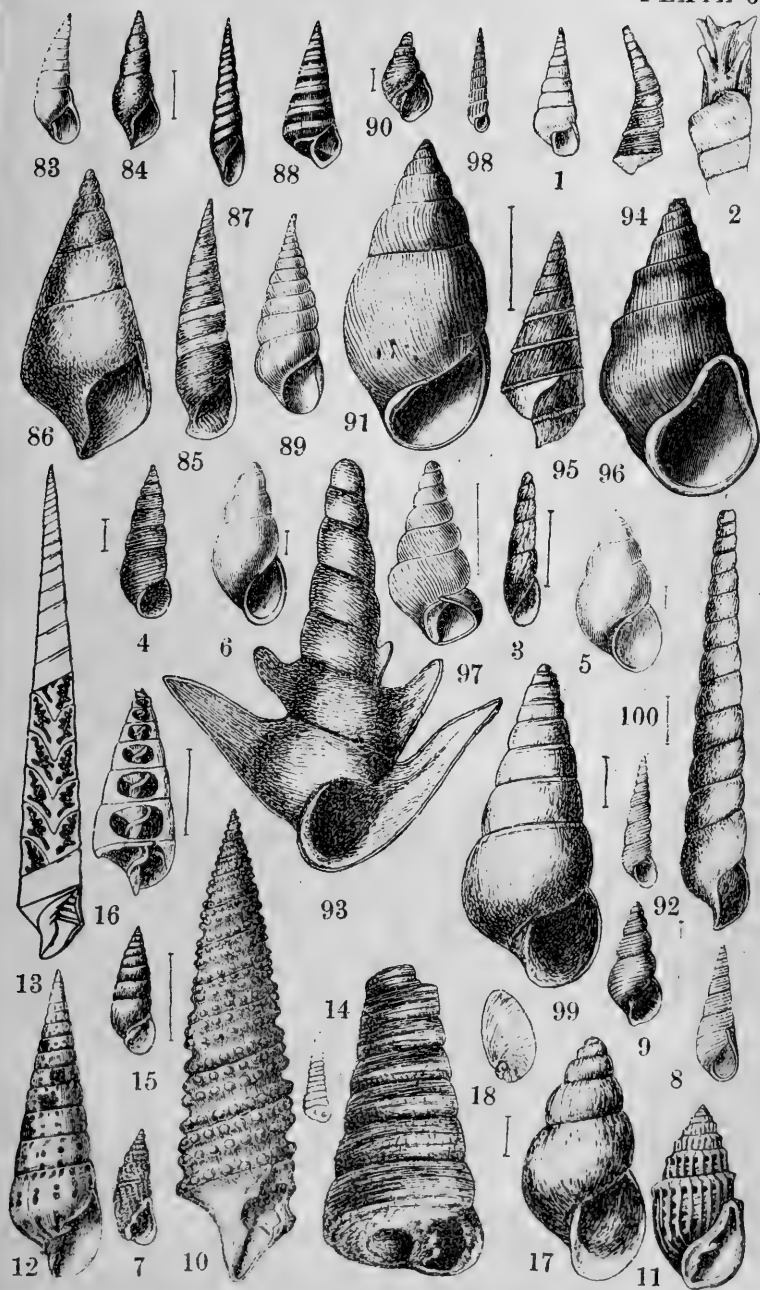
PLATE 66

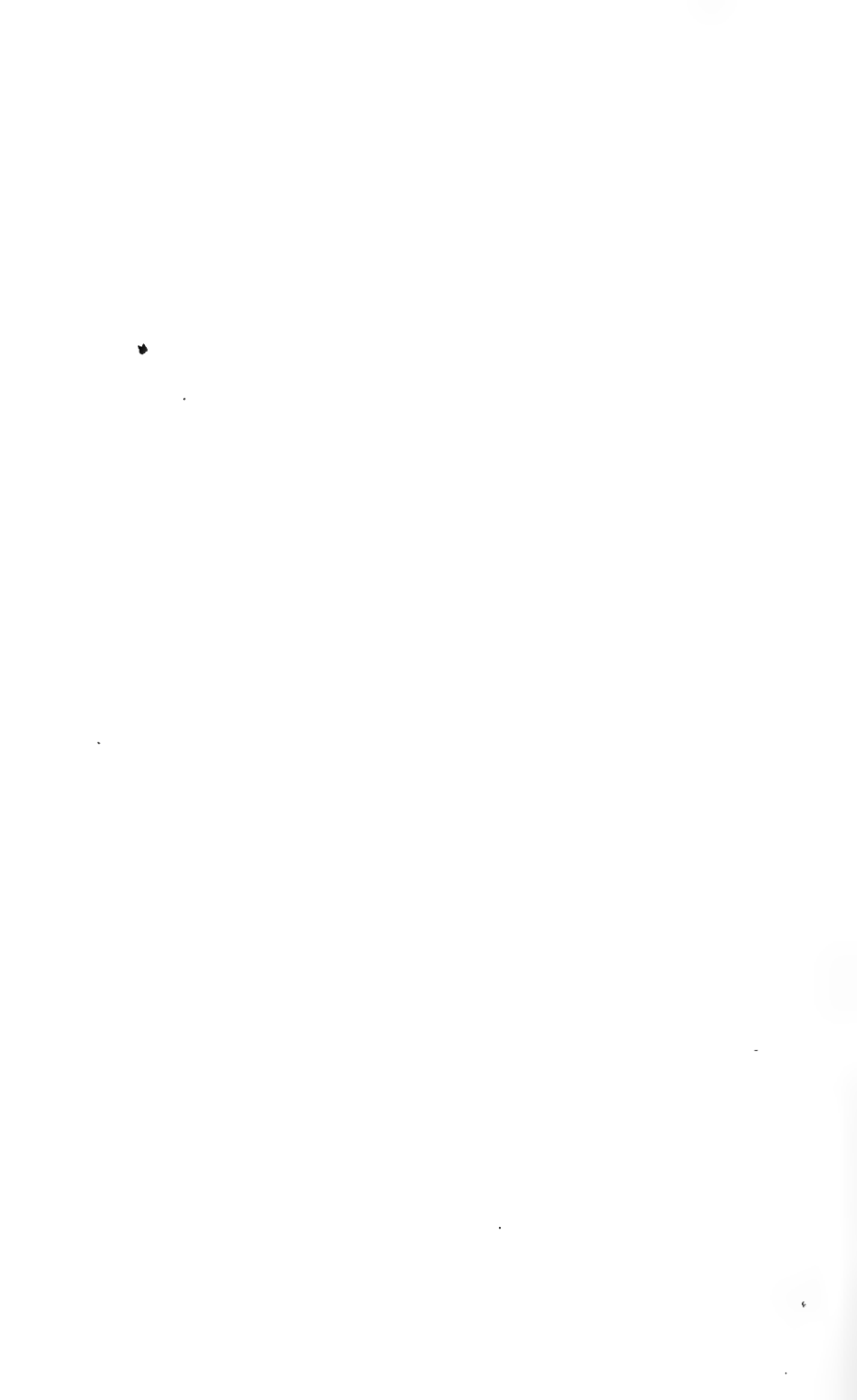


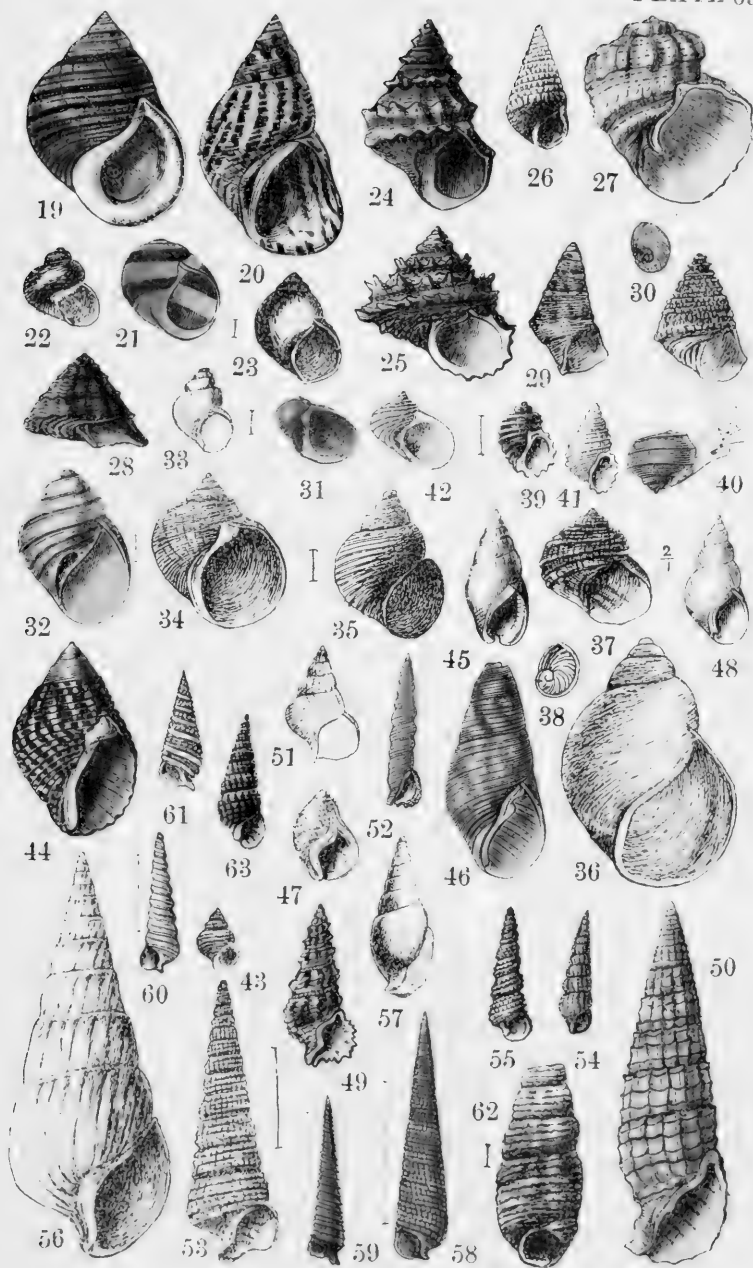












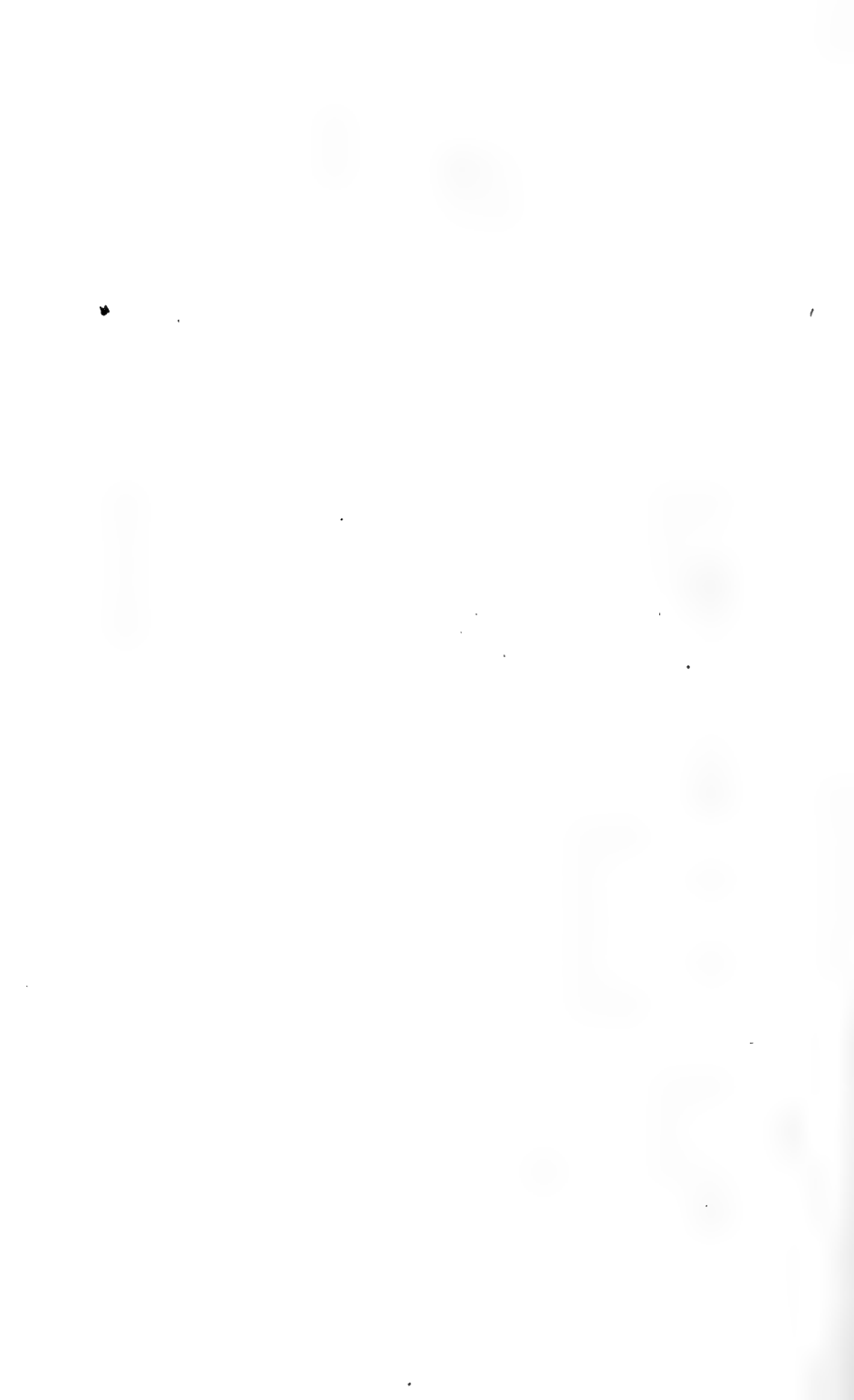
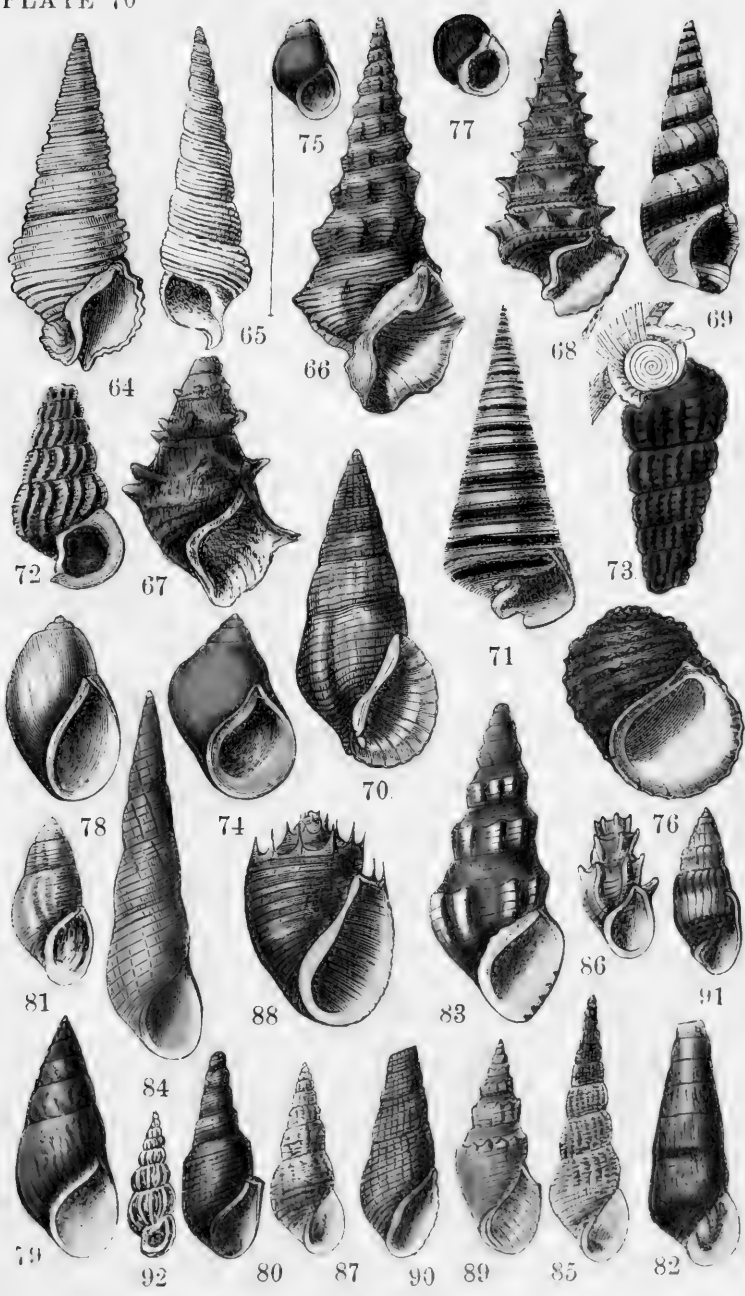
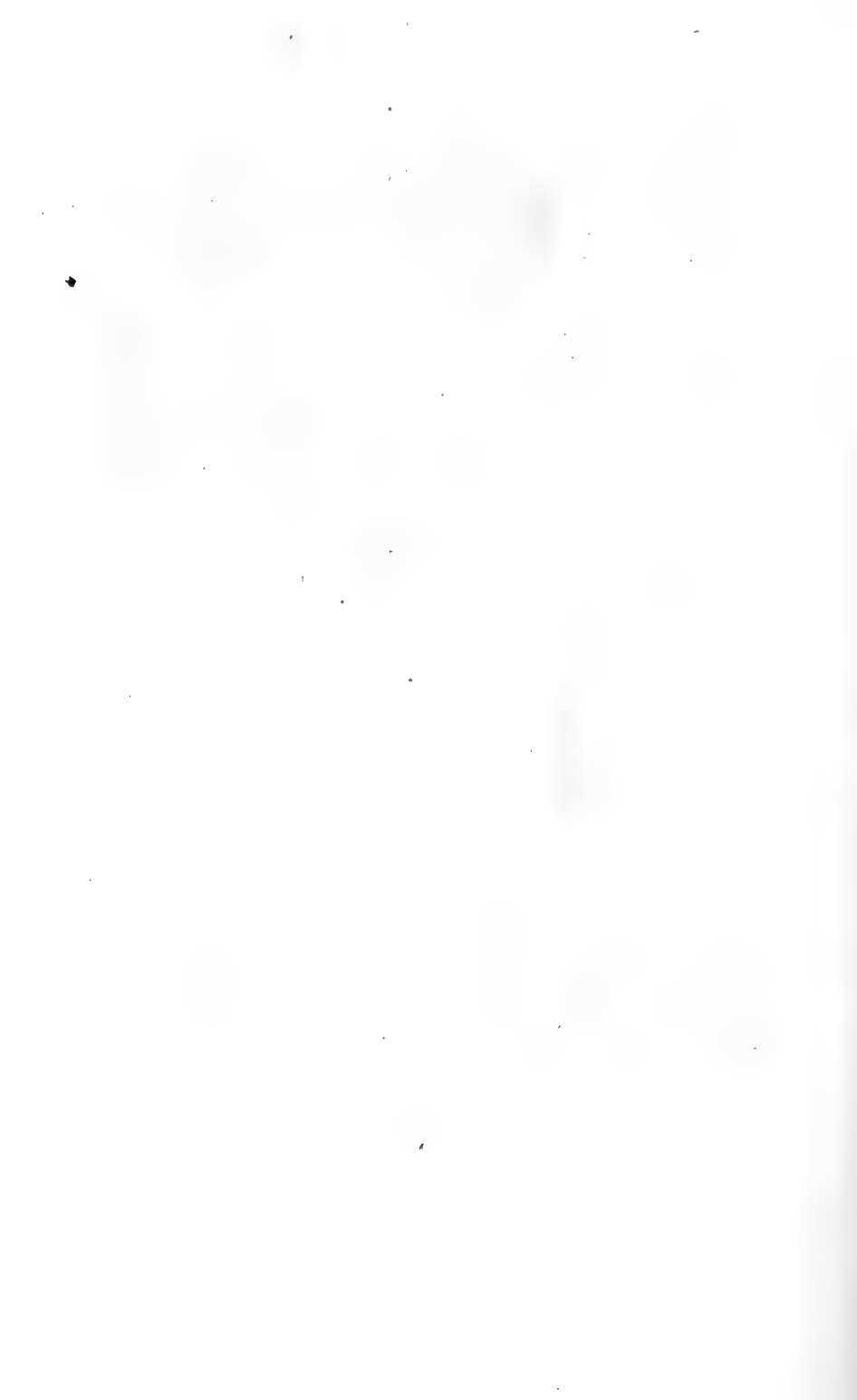
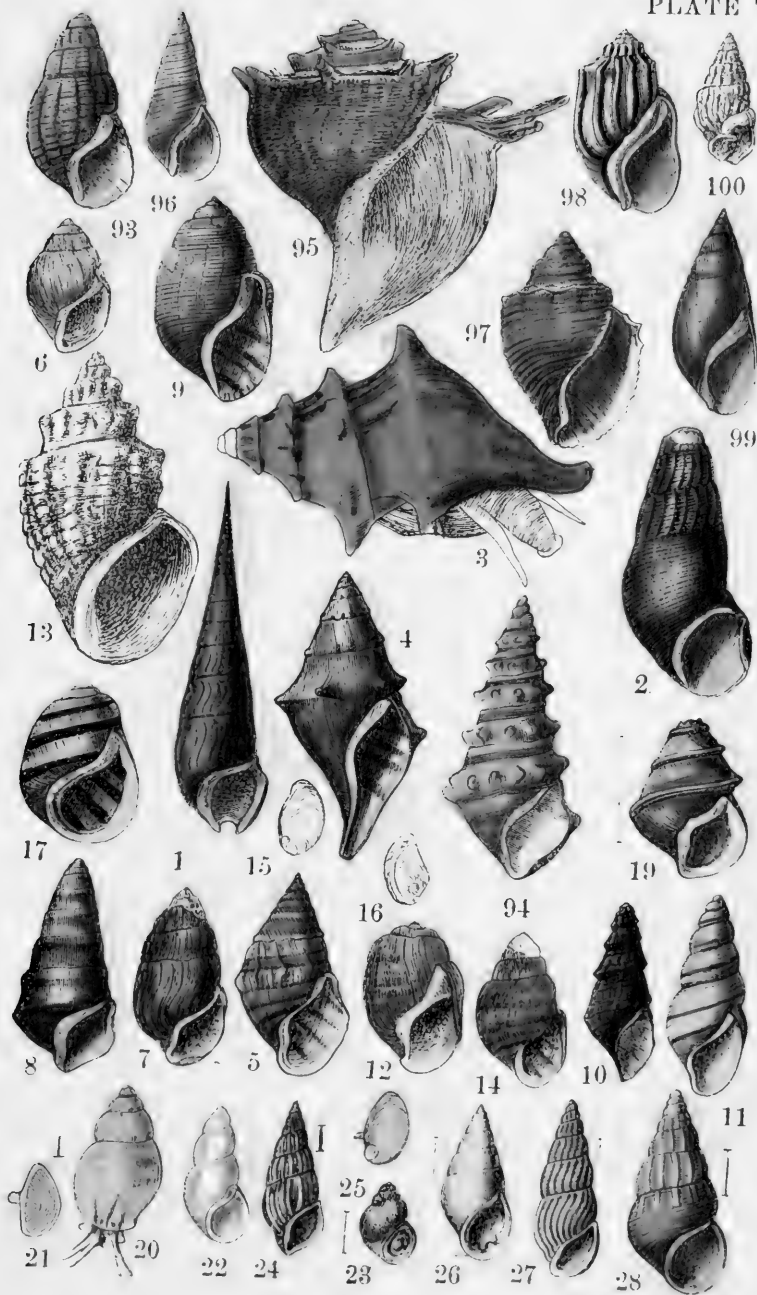
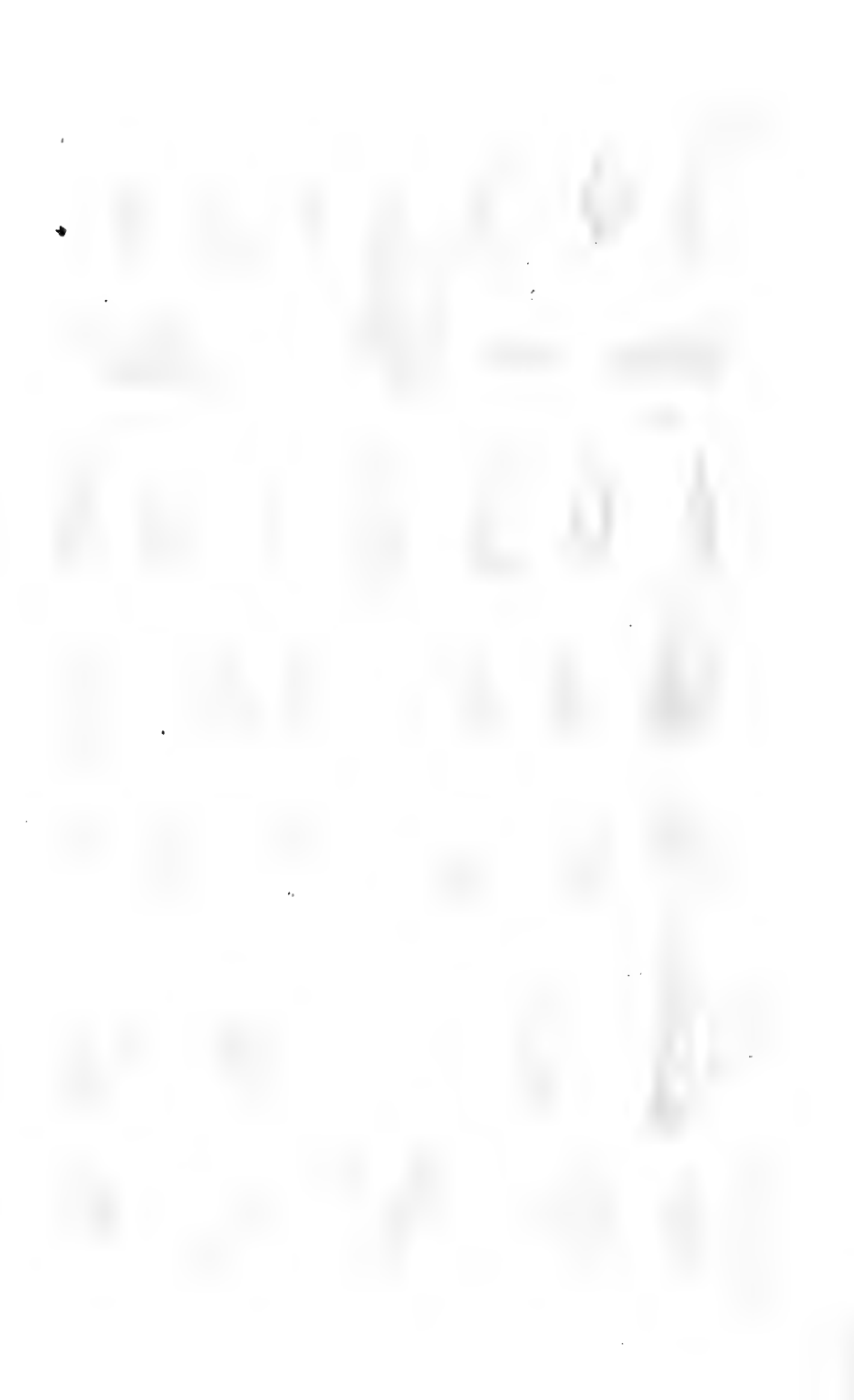


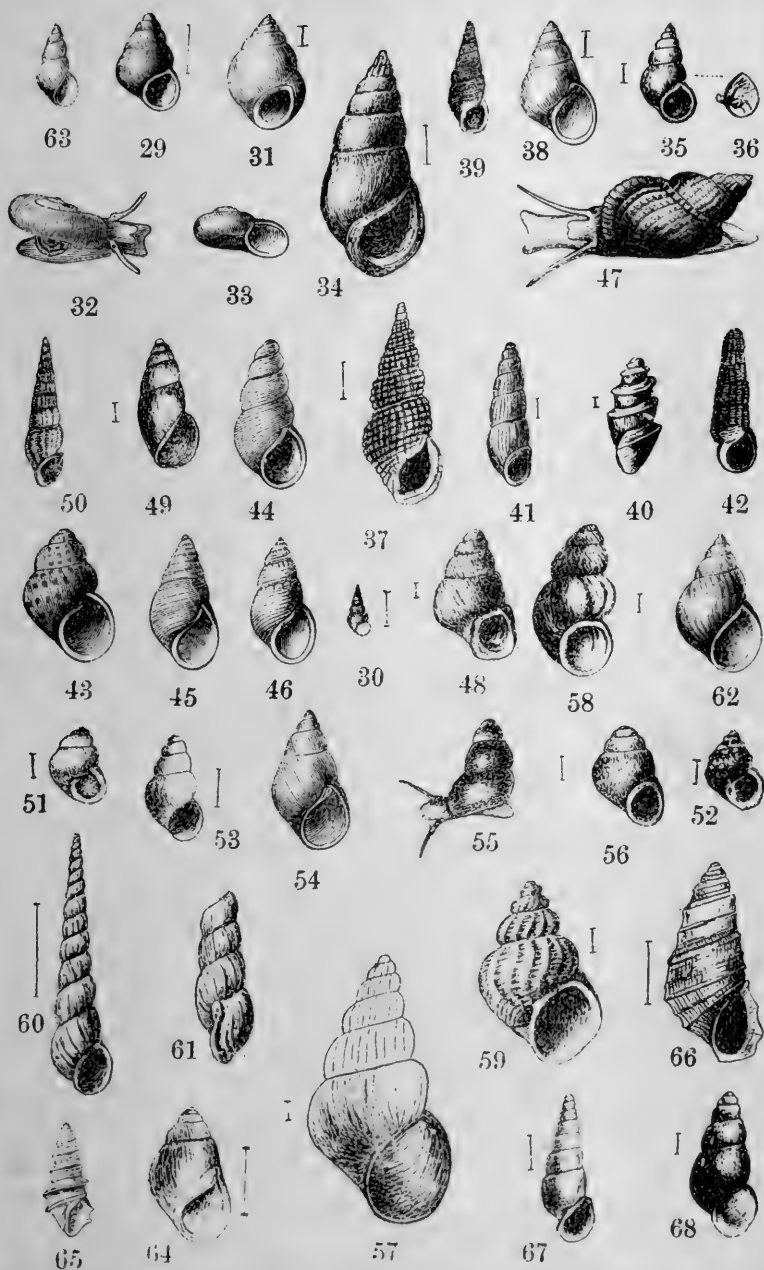
PLATE 70













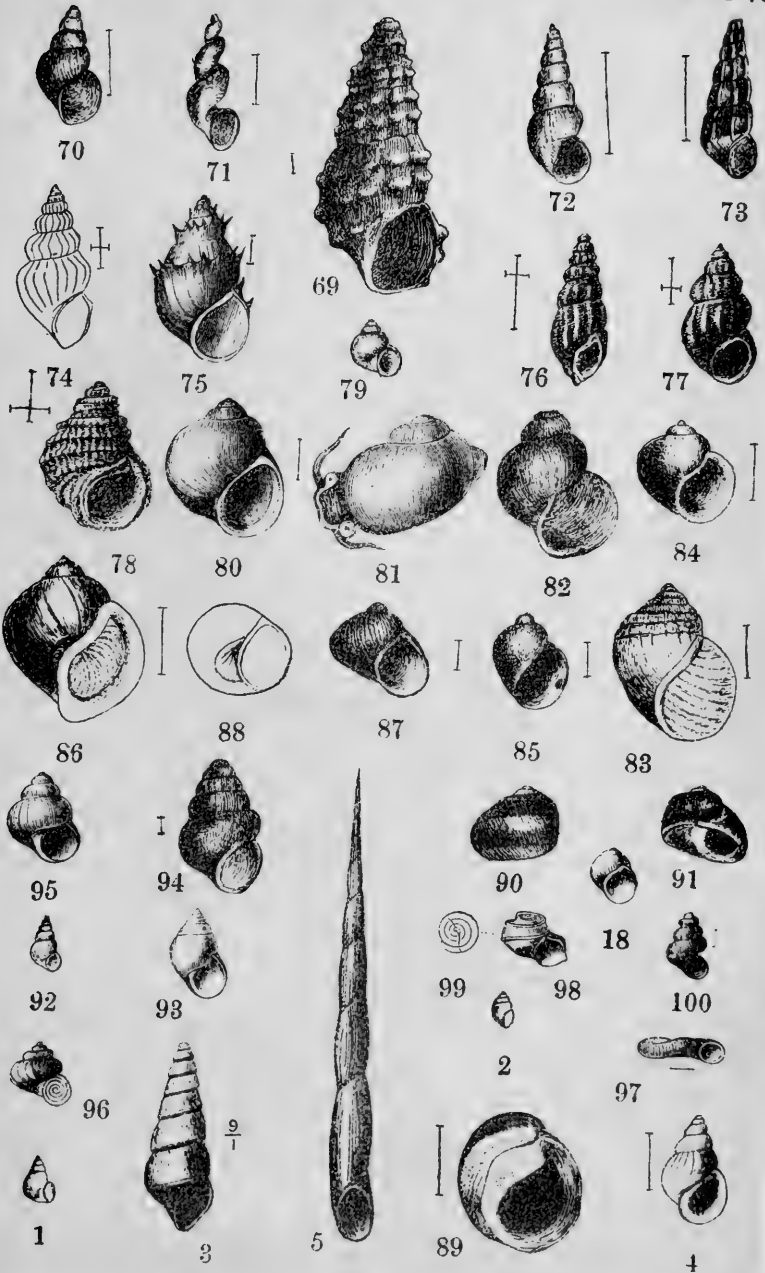
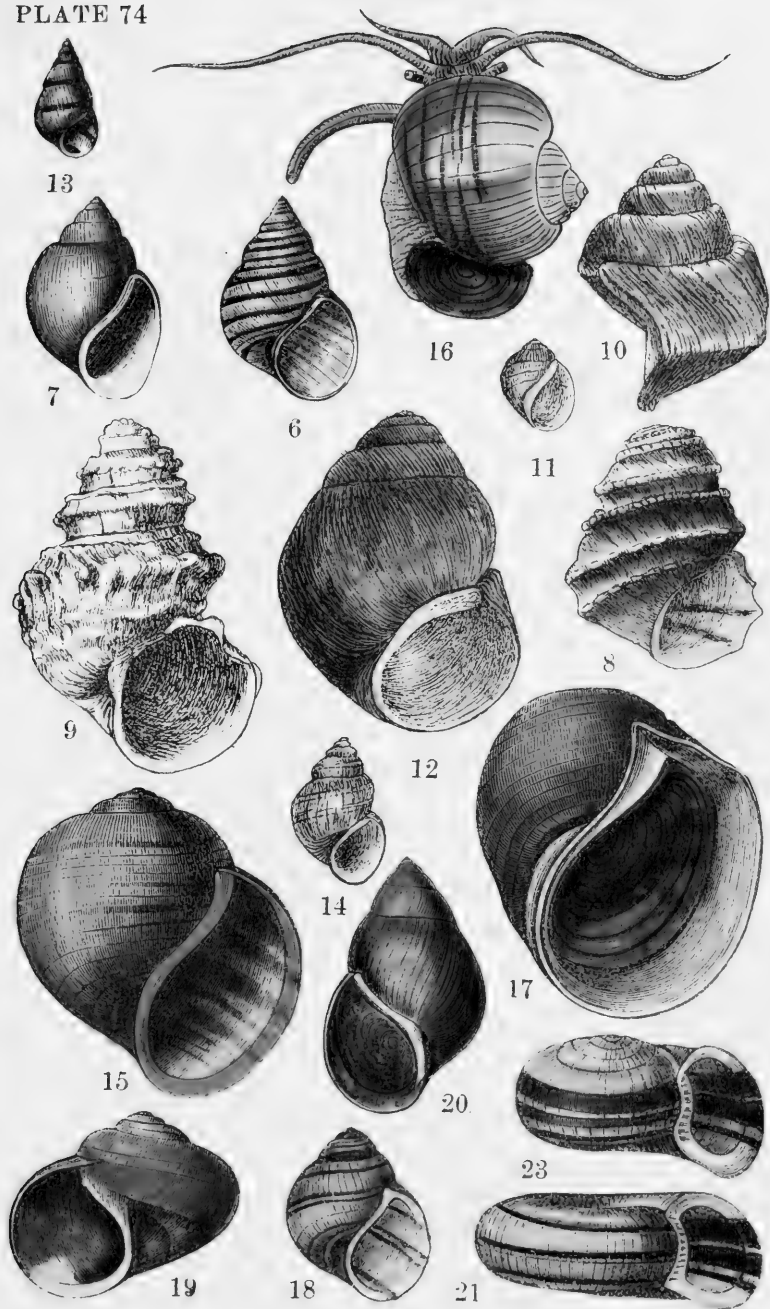
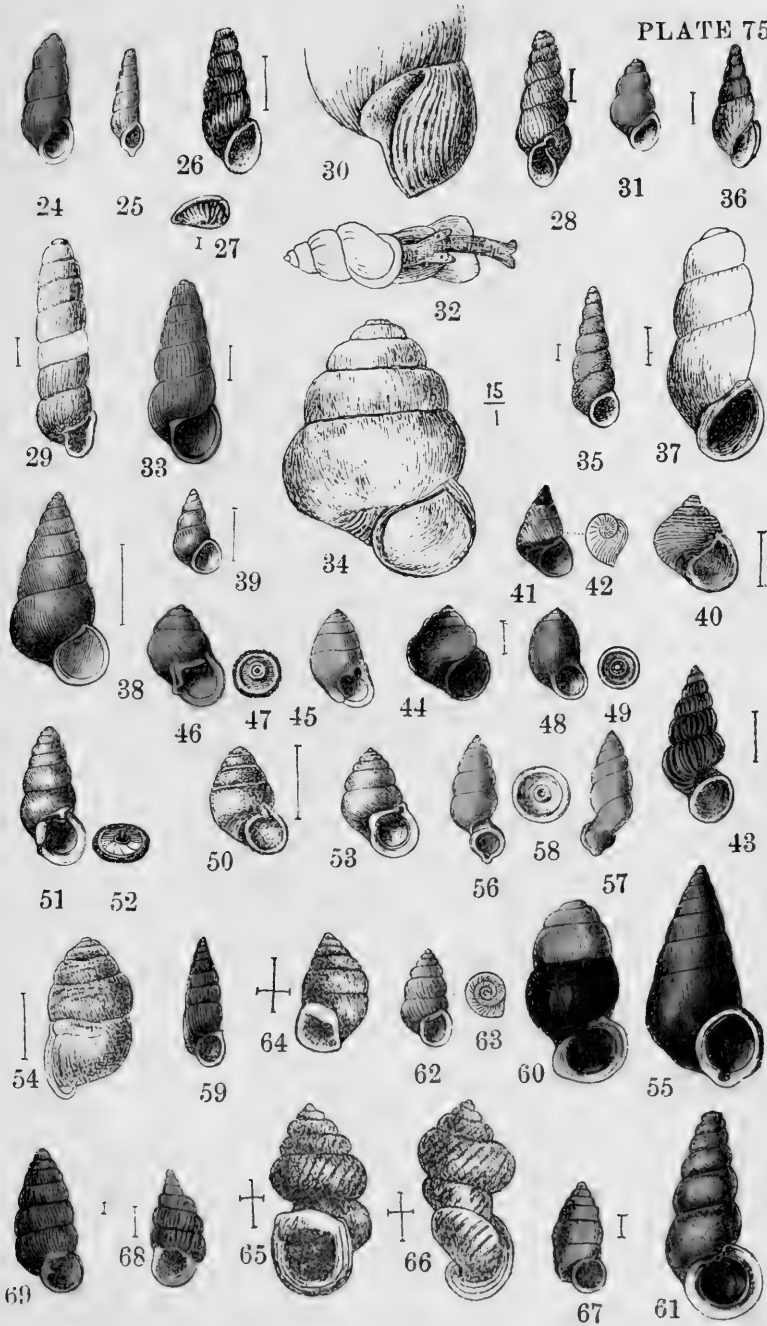


PLATE 74





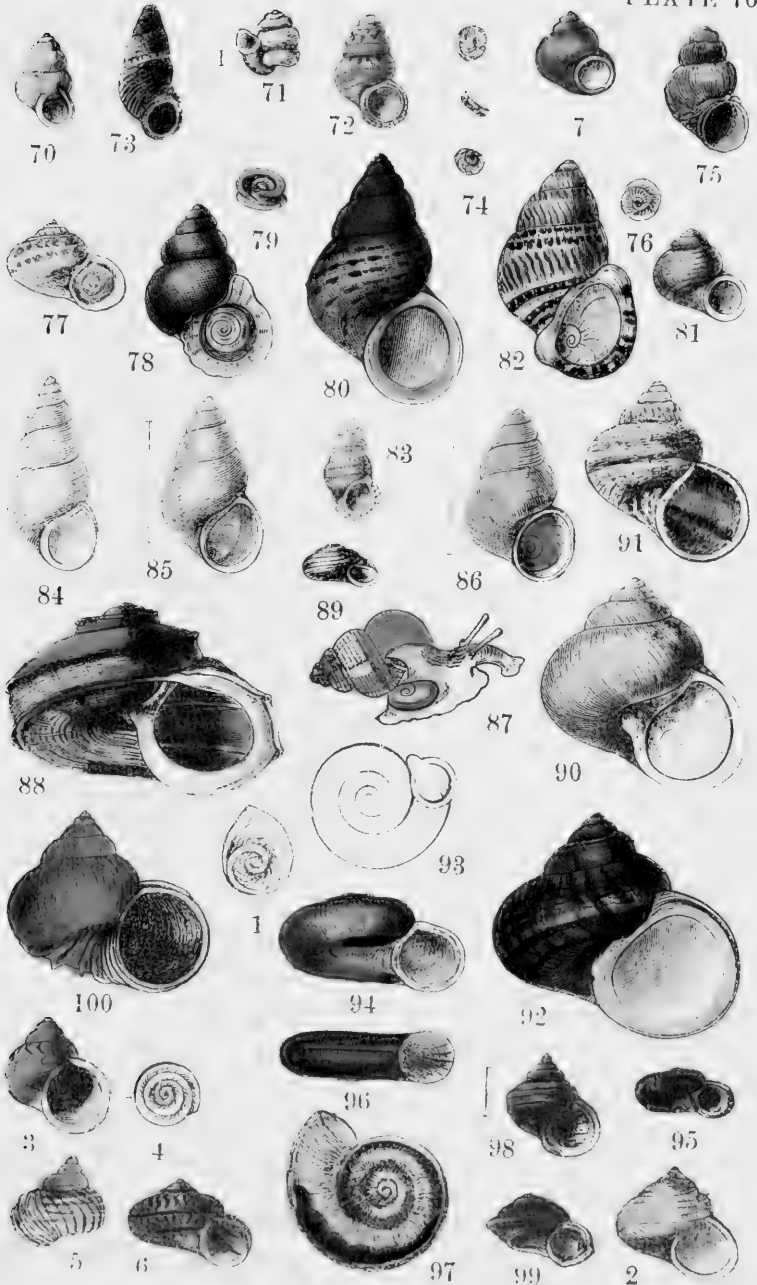
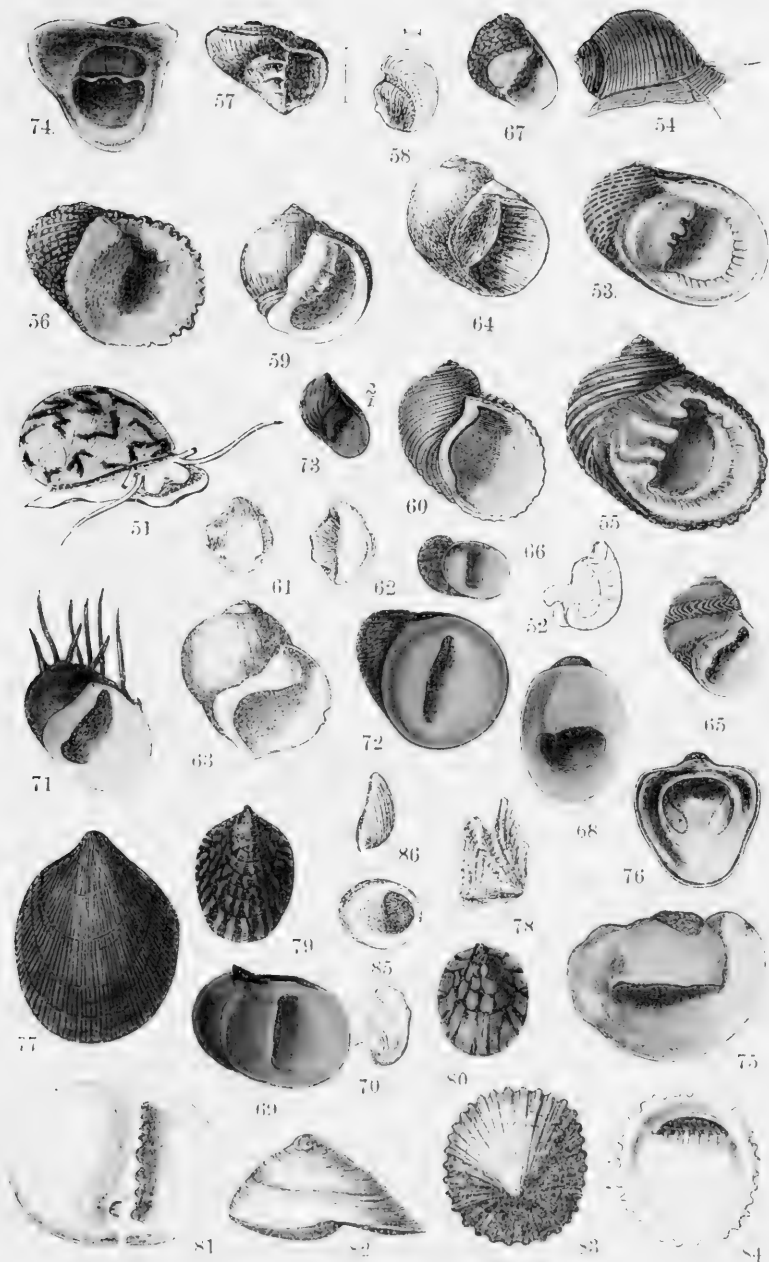
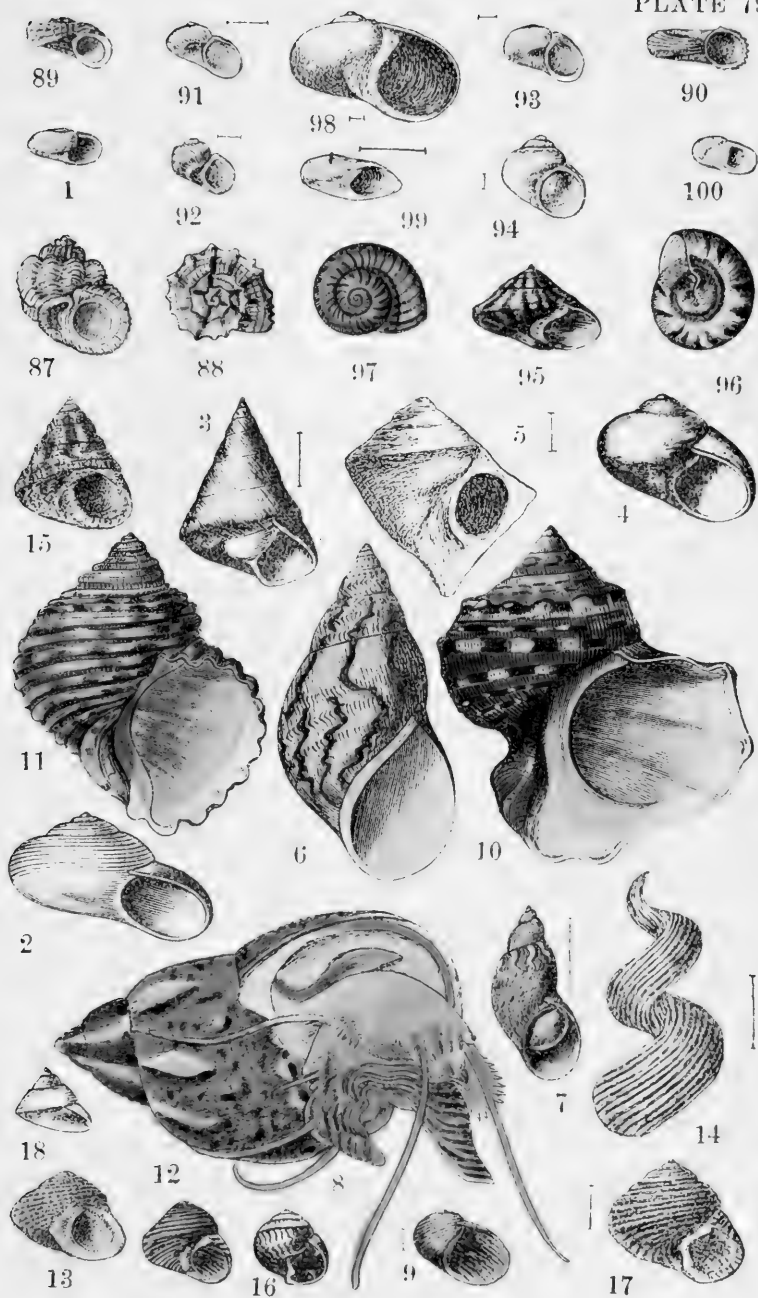
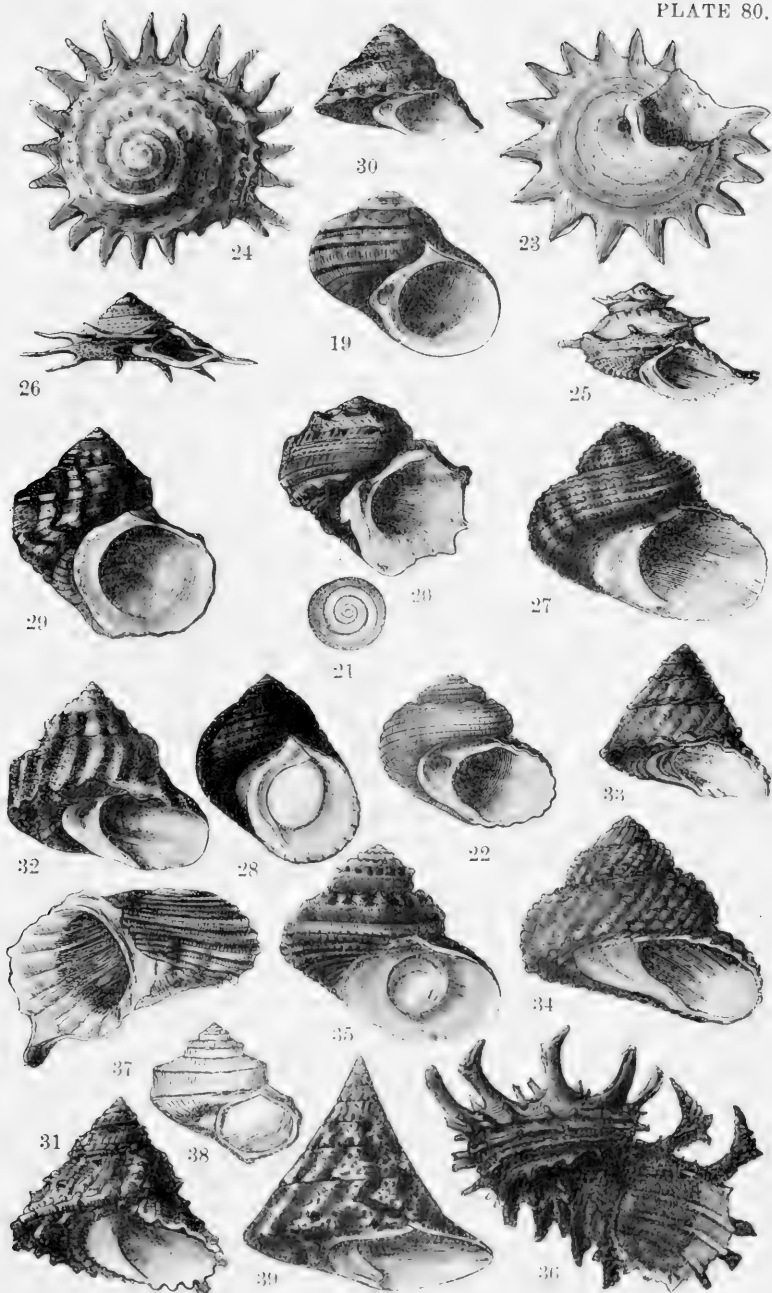


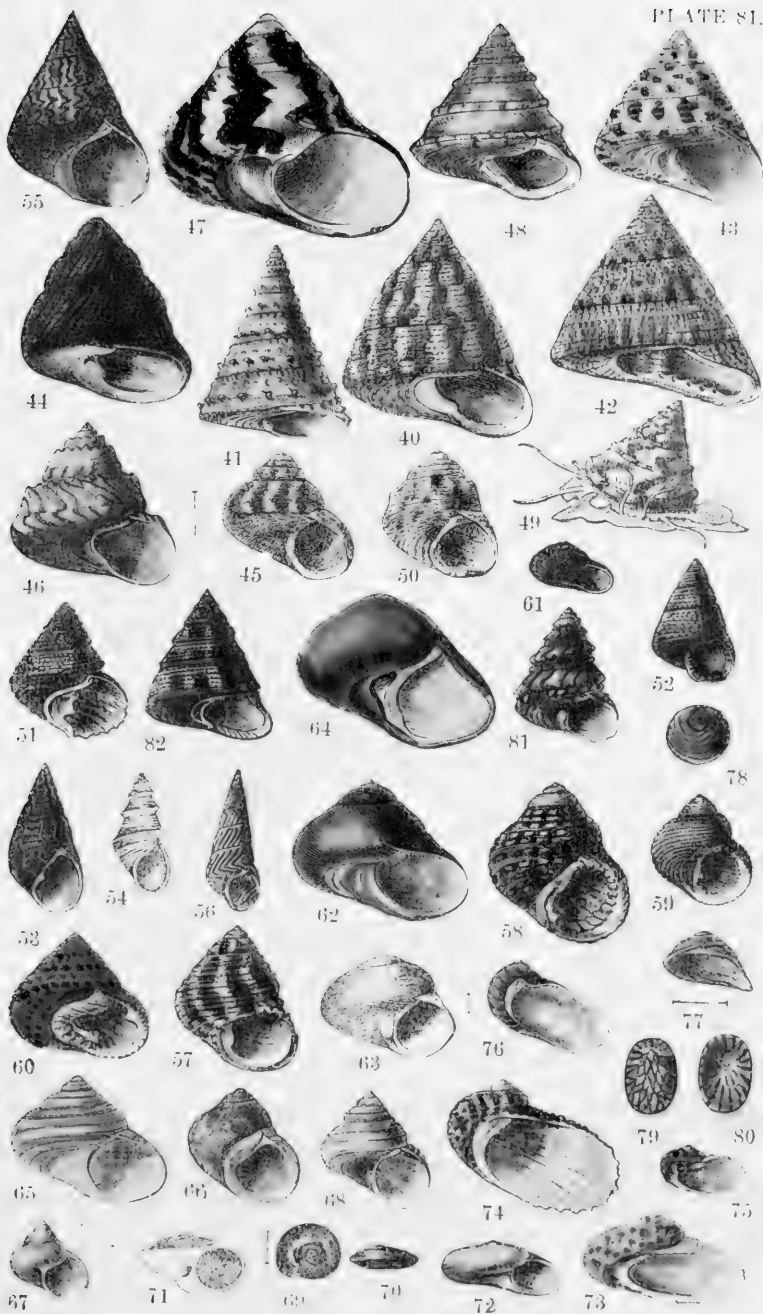


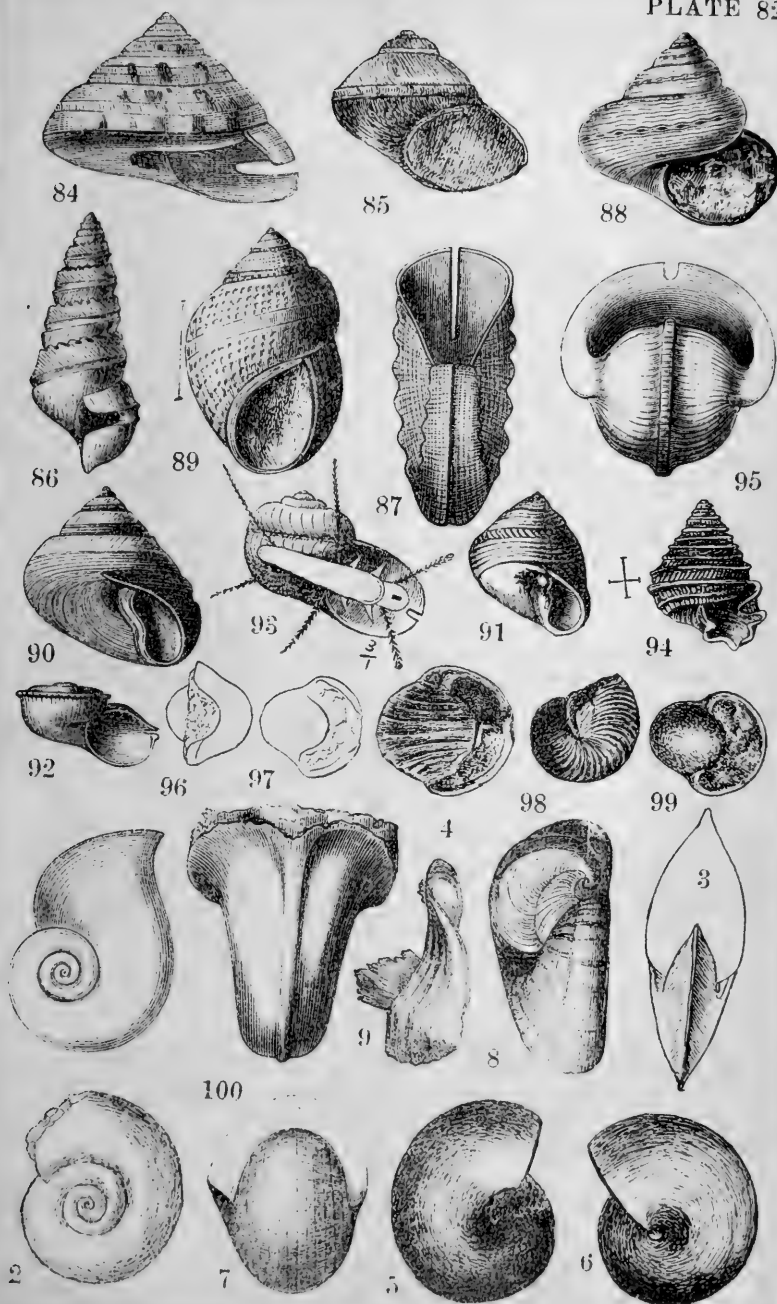
PLATE 78.

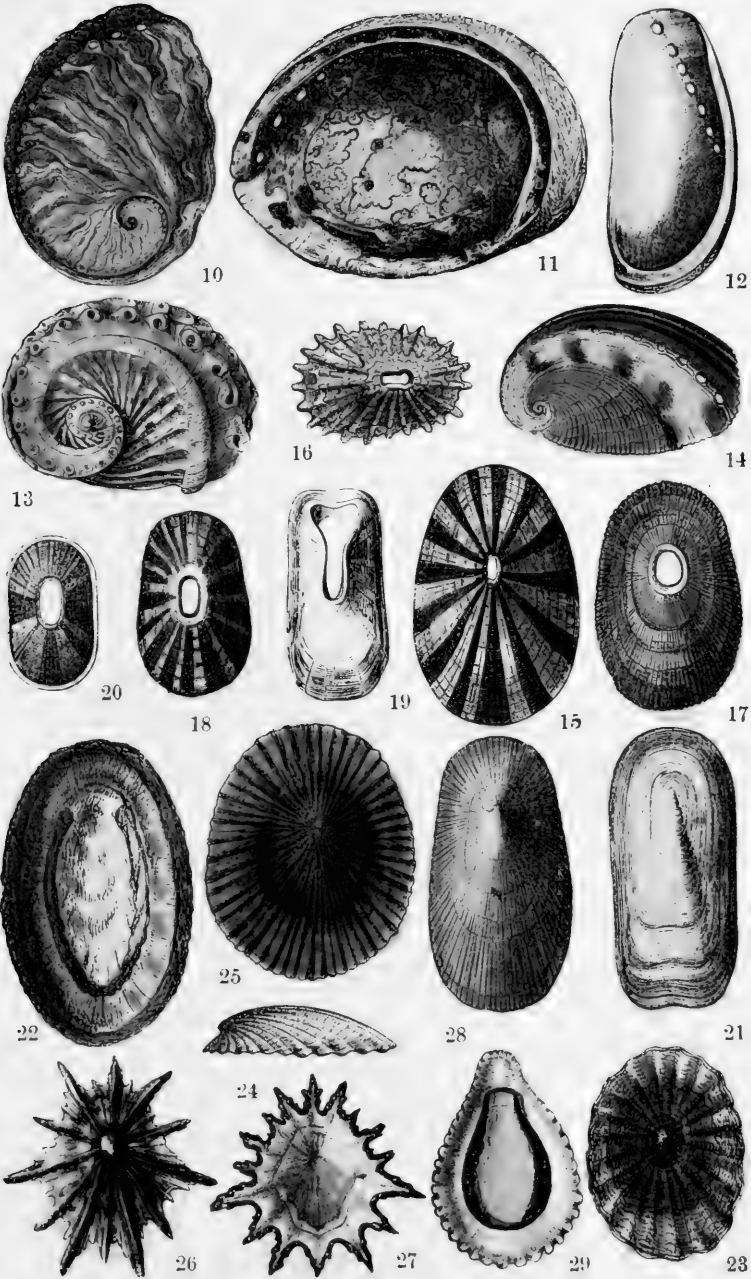




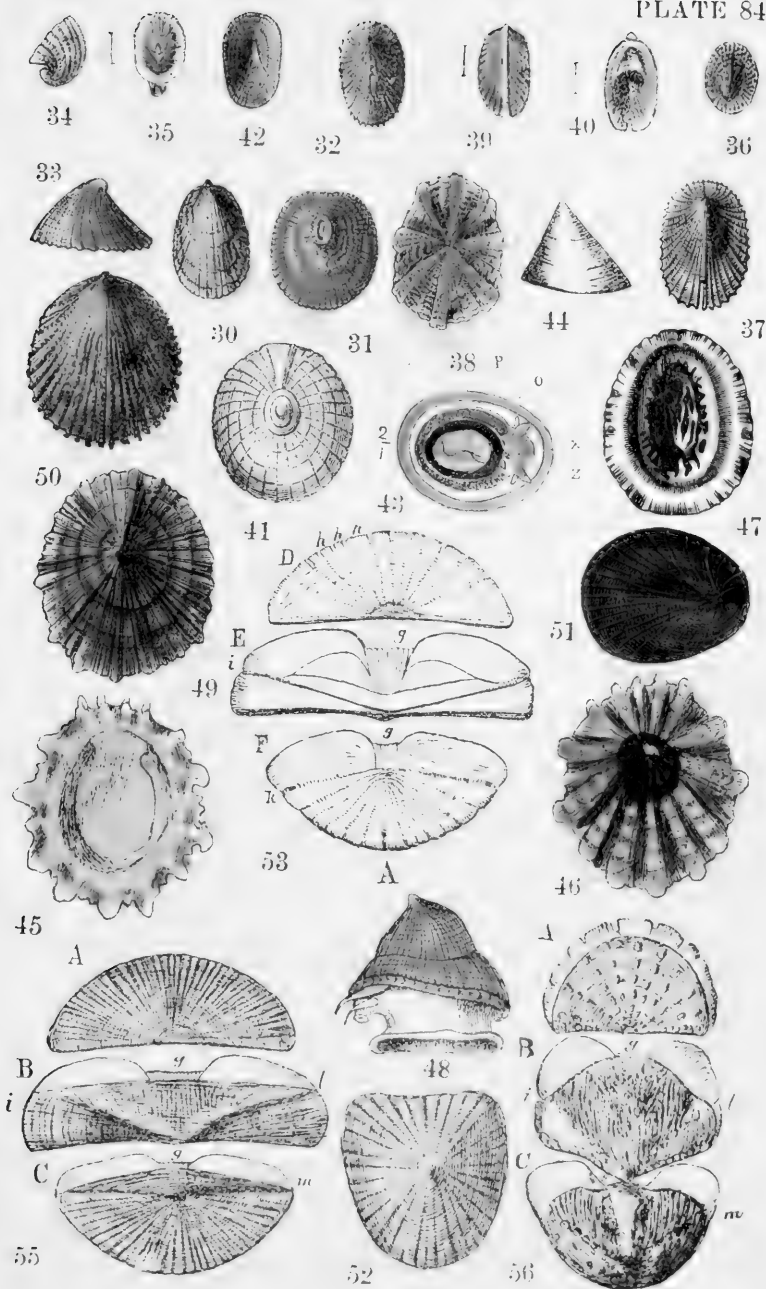


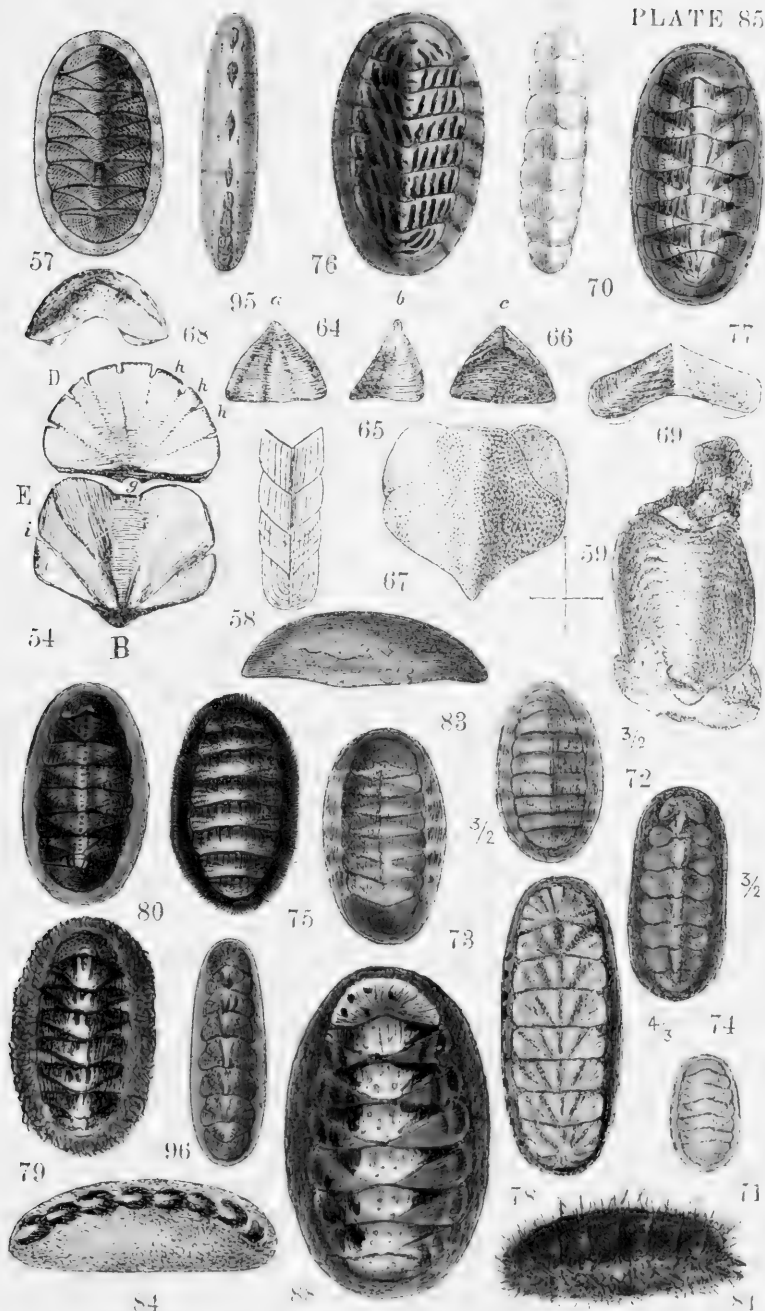






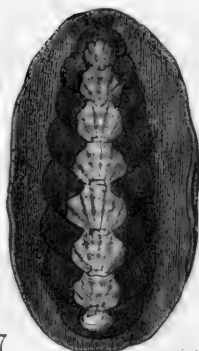
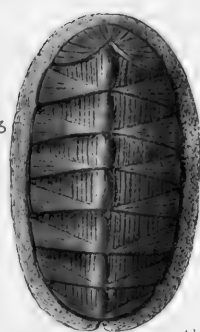








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85

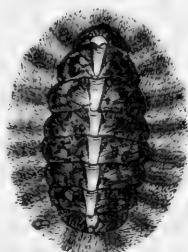
86

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91



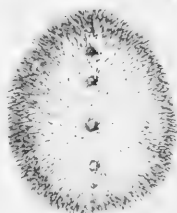
82.



89



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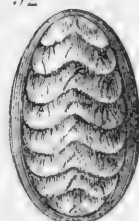
94



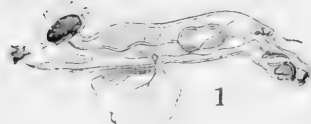
7



100



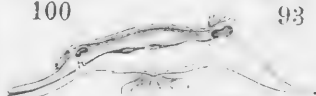
93



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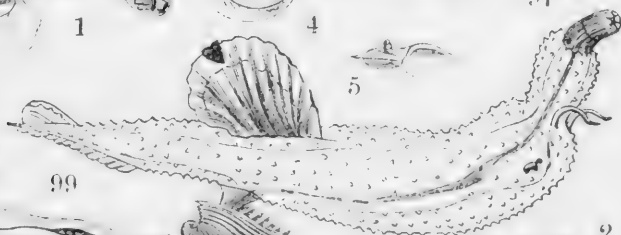


97

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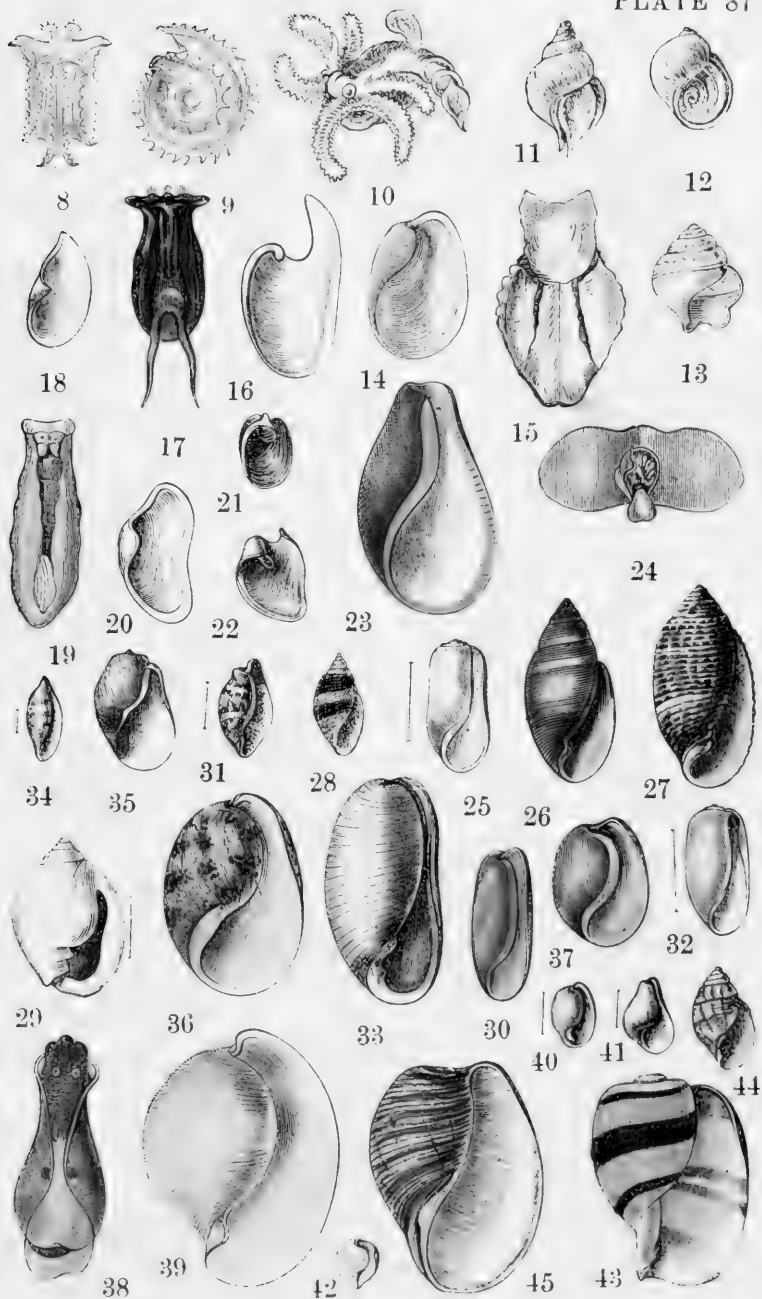
98



6

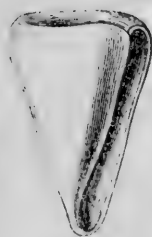


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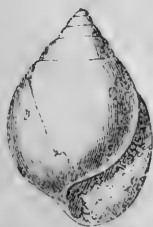
57



50



49



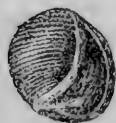
53



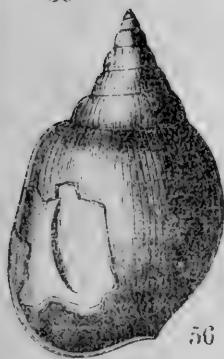
52



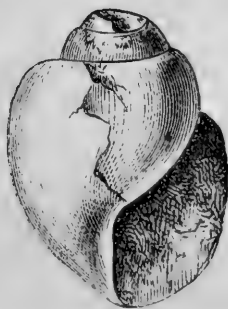
51



59



56



54



58



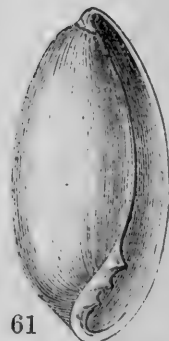
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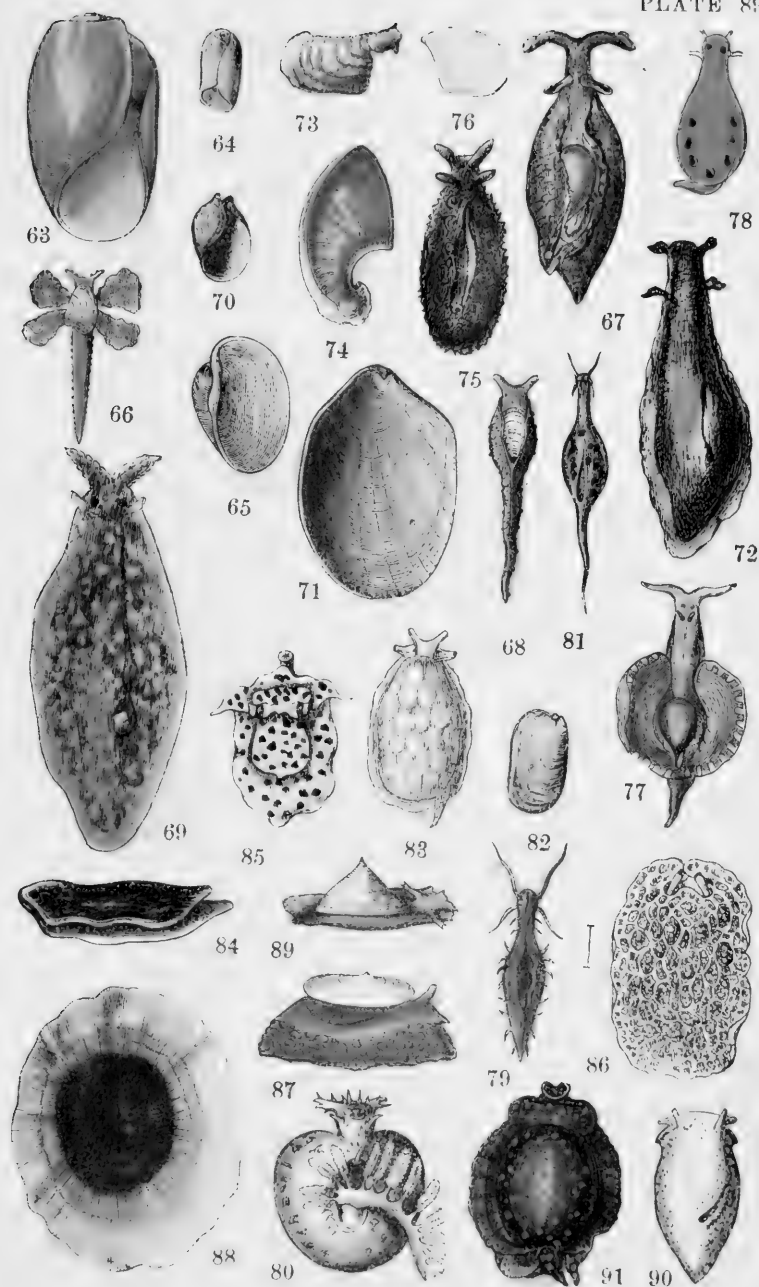
55

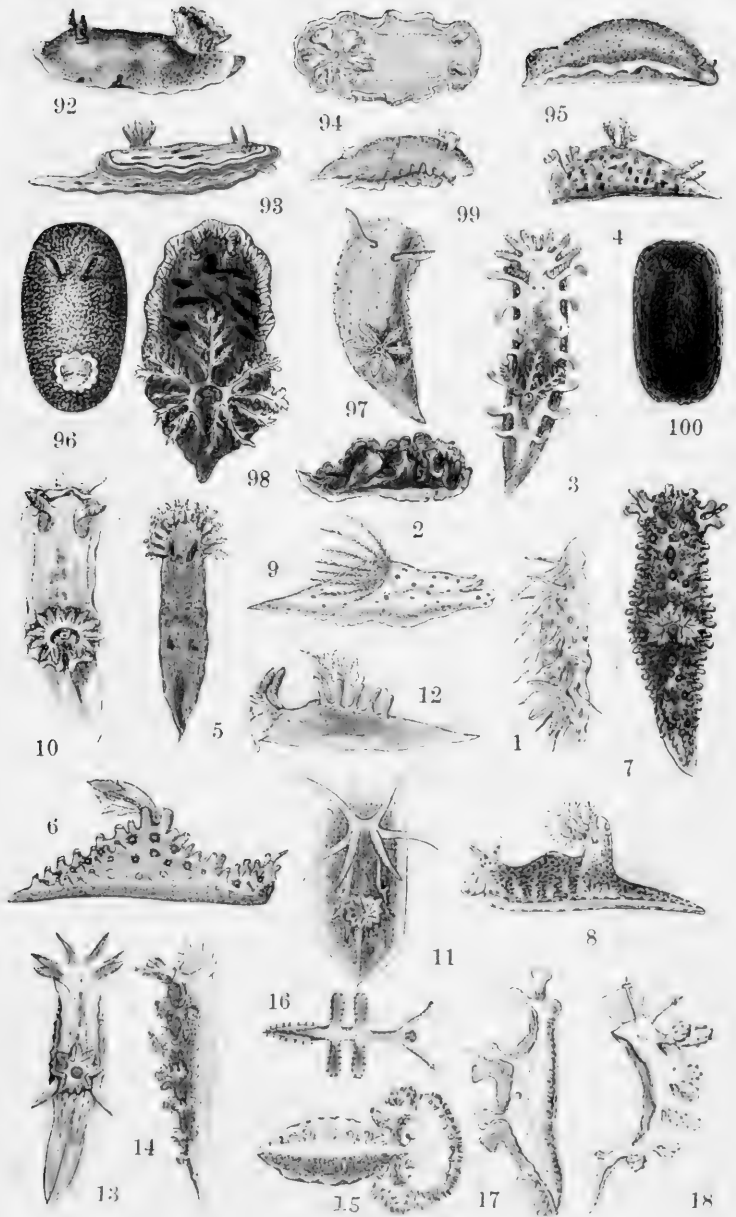


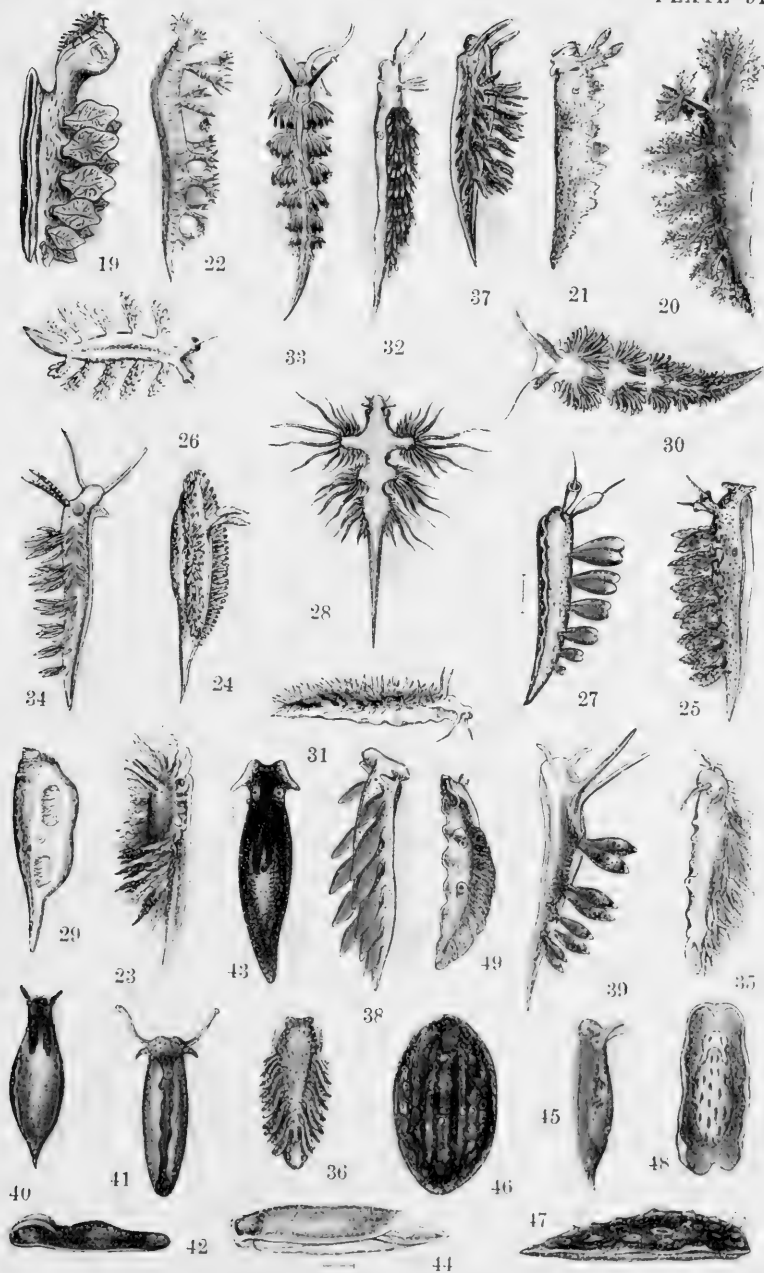
62

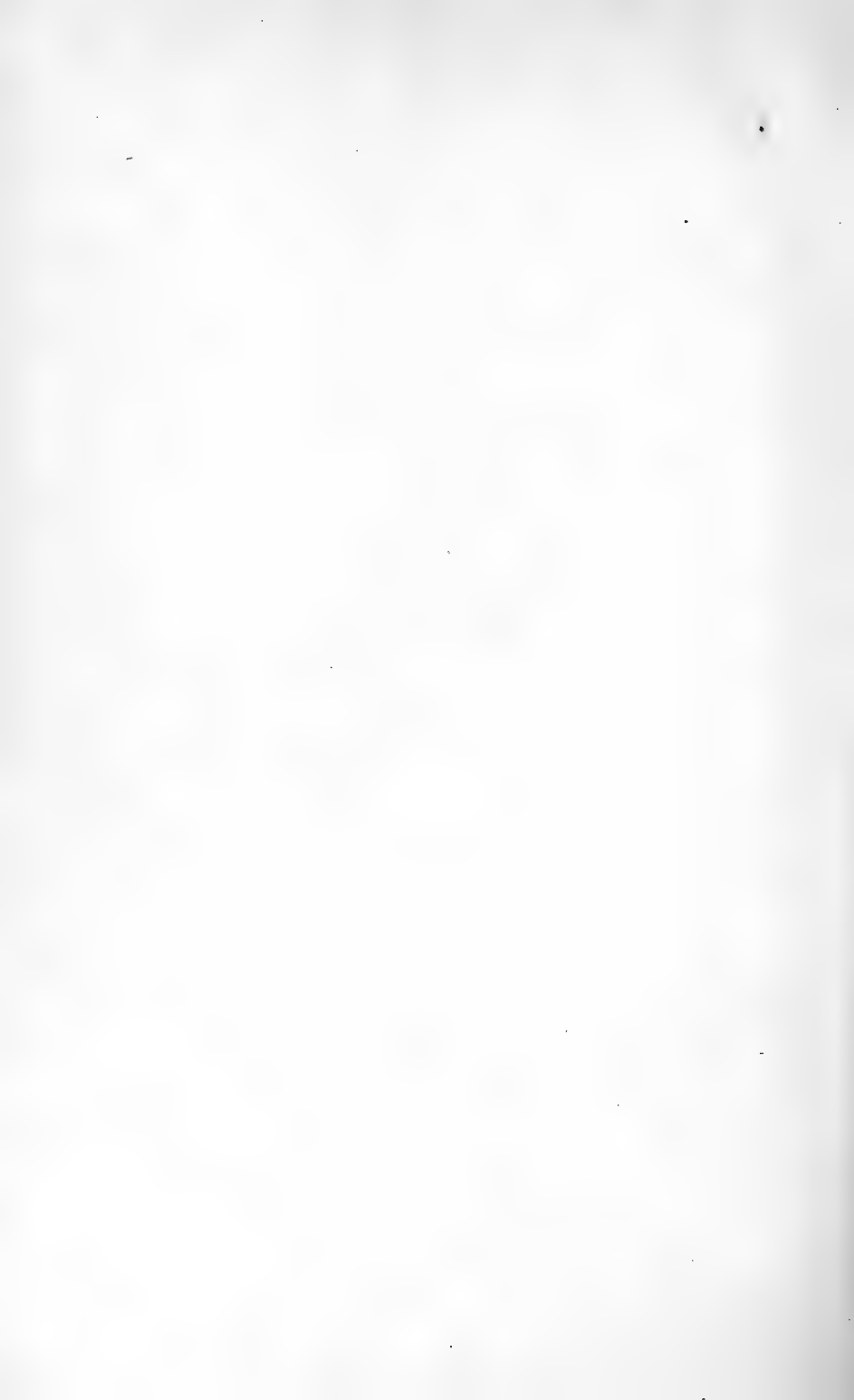


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